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THE
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OF THE
ABSORBING VESSELS.

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THE
ANATOMY
OF THE
ABSORBING VESSELS
OF THE
HUMAN BODY.

THE SECOND EDITION;

CONSIDERABLY ENLARGED, AND ILLUSTRATED WITH
ADDITIONAL PLATES.

BY WILLIAM CRUIKSHANK.

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THIS PUBLICATION CONSISTS OF TWO PARTS.

PART I.

Contains the history, structure, and properties of the Absorbing Vessels, and their Glands, in those animals in general in whom they have yet been found.

PART II.

Contains the situation and number of the Absorbent Glands, and the particular distribution of the Vessels, in the human body.

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INTRODUCTION.

INTRODUCTION.

About an hundred and sixty years ago, Asellius, an Italian anatomiſt, accidentally discovered a new species of vessels, on the intestines of a dog: he afterwards found similar vessels on the intestines of horses, and other quadrupeds; and, from analogy, supposed they existed also in men. The discoverer not only perceived that these were a new species of vessels, but, observing that they contained the same kind of white fluid which was contained in the cavity of the intestines, he was also led to their use; and asserted, that they took up the chyle from the intestines, and carried it to the liver, where, he imagined, it was converted into blood. He named them, *venæ lacteæ*, from the colour of their contents. These vessels were soon after discovered in men; but in them, as well as in quadrupeds, were supposed to exist only on the intestines and mesentery. Similar vessels, however, were soon discovered in other parts of the body, both in men and quadrupeds; but as they contained a watery, and not a white fluid, they were imagined to be different, and of course obtained a different name: they were termed, generally, *vasa lymphatica.*

The lacteals, it was admitted, arose from the internal surface of the intestines, and were not connected with the arteries or veins; but Bartholin, one of the discoverers of the lymphatics, taught, and the generality of anatomists believed, that they were continued from the arteries, and served the purpose of carrying back the watery part of the blood to the heart; but their assertions were vague, unaccompanied with experiments, and unsupported by any ſtrong arguments. Some of the more eminent anatomists suspected this doctrine, and asserted, that the lymphatics also absorbed fluids from surfaces. The late Dr. Hunter, particularly, taught this doctrine, and urged the following arguments in its favour:—The lacteals arise from the surfaces of the intestines, pass through the conglobate glands, terminate in the thoracic duct, and are, beyond dispute, absorbents. The lymphatics resemble the lacteals in a number of circumstances:—Their coats are equally thin and transparent; they are equally crowded with valves, for which no good reason can be given, supposing them to be continued, as has been imagined, from the arteries; they also pass through conglobate glands; they also, like the lacteals, appear to have no connexion with arteries, for they cannot be injected from them, as the red veins can; they also terminate, at last, in the same common trunk with the lacteals, the thoracic duct; and laſtly, they too, appear to rise from surfaces; for if the venereal poison is applied to the surface of an ulcer, and passes into the blood, it passes through the lymphatic vessels, it sometimes inflames their coats, and makes them, in consequence of this, appear in the form of red lines; it frequently inflames the glands through which they pass, and, some time after, shews itself in the constitution, by symptoms peculiar to itself: on the contrary, if such inflamed glands are presently extirpated, the poison is removed with them, and the constitution will be prevented from being infected. He farther observed, that when injections thrown into the arteries or veins, were extravasated, from rupture of the vessels, they got into the cellular membrane, and very commonly from thence into the lymphatic vessels; or if a tube loaded with quicksilver, was pushed, at random, into the cellular substance of a gland (the testicle, for example) the quicksilver would frequently pass into the lymphatics of that part. The venereal and other poisons passing into the lymphatics from the skin, proved their origin from surfaces; and the extravasated injections passing into the same vessels, from the cellular membrane, proved, in his opinion, their origin from cells. Thus, a grand system for absorption, in men and quadrupeds, was formed, and the lacteals and lymphatics were blended, under the common name of *absorbents*. Dr. Hunter enjoyed the honour of this discovery for many years. At first professor Monro was his only rival. The medical world were not always certain to which of these gentlemen the credit was due; but there were no doubts that one of the two was certainly entitled to it. Dr. Hunter, in his Medical Commentaries, supported his claim so well, that the greater part of those who were entitled to hold any opinion on the subject, were on his side. Lately, attempts have been made to wrest this discovery from Dr. Hunter, and to give it to others. The same fate happened to Harvey, and happens to discoverers in general. When Harvey discovered the circulation of the blood, his opponents first attempted to prove that he was mistaken; but finding this ground untenable, they then asserted that it was known long before; Servetus, Columbus, and Cesalpinus, all knew it: and when they were informed, that if these gentlemen did know any thing of the matter, the world at large were totally ignorant of the fact, and likely to have continued so, except for Harvey, they once more shifted their ground, and said the discovery was of no use. Harvey, however, at present remains in full possession of his discovery; nor is there the smallest probability of his ever losing his title.—Objections were made, and still are made to Dr. Hunter's theory. It was said, that the lacteals and lymphatics cannot form the absorbent system. In the first place, Hippocrates and Galen have asserted the absorption by red veins, and their authority has been deservedly respected. 2. Experiments made on purpose, by the moderns, are alleged, in confirmation of this absorption by red veins: they have imagined that they have proved that the veins arise from surfaces, by open mouths; for which structure no good reason can be given, unless they are absorbents. 3. Chyle has been supposed to have been actually seen in the veins of the intestines: it could not be there unless they had absorbed it: and if veins absorb on the mesentery, they must absorb every where else. 4. It is alleged, that there are parts of the human body, where no lymphatics are to be found. 5. The lymphatics which have been found, are not sufficiently numerous to be capable of performing so important an office as absorption. 6. It was also said, that there were no lymphatics in amphibious animals, in birds, and in fishes; absorption, therefore, in them, must be performed by the red veins: but if red veins absorb in any of the classes of animals, it is more than probable they also absorb in the human body; the Author of Nature never could have formed two sets of vessels to do the same thing.

To obviate all these and some other objections, was Dr. Hunter's intention in projecting this work. In some part or other, they will be severally replied to. Mean time, I have chosen to quote a passage from his introductory lectures to his course of anatomy, lately made public; partly, because it explains the intention of the work; partly, because the different assistants he had in collecting materials for it, are there mentioned; and partly, because it will explain how I come to be employed in composing it.

"In our own times, after schools of anatomy have long flourished, in all the civilized nations of Europe, and when, from the number of men employed in such researches, it might have been imagined, that discoveries were exhausted, Providence has allowed me a greater share of that sort of honour, which is generally given to discoverers, than I could have expected.

"I think I have proved, that the lymphatic vessels are the absorbing vessels, all over the body; that they are the same as the lacteals; and that these, all together, with the thoracic duct, constitute one great and general system, dispersed through the whole body, for absorption; that this system, only, does absorb, and not the veins; that it serves to take up and convey whatever is to make, or to be mixed with, the blood, from the skin, from the intestinal canal, and from all the internal cavities or surfaces whatever. This discovery gains credit daily, both at home and abroad, to such a degree, that I believe we may now say, it is almost universally adopted: and, if we mistake not, in a proper time it will be allowed to be the greatest discovery, both in physiology and pathology, that anatomy has suggested since the discovery of the circulation!—The anatomists of all Europe, for a hundred years, in the most improved state of our art, from all their enquiries, were of opinion, that the lymphatic system was wanting in birds and fishes. But having found out the importance of the absorbent system, in man and in all quadrupeds, we could not rest satisfied that it was wanting in the other two great classes of animals; and kept that object, and every thing which could throw light upon the absorbent system, constantly in view.

"Accordingly, my brother, Mr. John Hunter, whom I bred to practical anatomy, and who worked for me, and attended my dissecting room, and read some lectures for me, many years, found some lymphatics, first in birds, and then in a crocodile.

" Next, Mr. Hewson, whom I bred to anatomy, and then took into my house to work for me, and under my direction, in practical anatomy, to attend my dissecting room, and read some lectures, as my partner, which he did for a number of years; Mr. Hewson, I say, by a continued course of observations and experiments made in this house, discovered, and fully demonstrated, the lymphatics and lacteals, both in birds and fishes; which confirmed the use and importance of the absorbent system in the human body, and, in comparative anatomy, was one of the greatest improvements which could have been made, to establish the universality of Nature's laws in animal bodies.

" And, laſt of all, Mr. Cruikshank, whom I likewise bred to anatomy, and took into my house, upon the same plan, with the opportunities he had in this place, and by being particularly attentive to the lymphatic ſyſtem, at my desire, has traced the ramifications of that ſyſtem in almoſt every part of the body; and from his dissections figures have been made, which, with what I had before, will enable us to publish, we hope, in a little time, a full account of the whole ſyſtem, illustrated by accurate engravings."

In consequence of Dr. Hunter's death, this business has now fallen on me. I should have had no small share in it, if he had lived; for I had made almost all the preparations, from which the drawings were made, and from which the description would then have been, and still is, taken.

The description I have here given of the absorbent vessels, is nearly the same with that which I have given in public, in the anatomical lectures in Windmill Street, in 1773, and ever since that time. There I not only shewed the gentlemen who attended, such parts of the system as I occasionally discovered, but also in what manner I succeeded in detecting them, and how they would be able to succeed themselves. How far others have been indebted to me for their descriptions, will appear by comparing them with this work.

In the present publication we have many reasons to regret the loss of Dr. Hunter. It has so happened, that we shall be able to derive no advantage to it from his fortune, which has been otherwise disposed of. The work, from this circumstance, cannot appear at present with the number of plates it would have done, had he lived to publish it himself: we have also sustained considerable loss, in being deprived of his extreme accuracy, good taste, and unwearied perseverance.

I meant to exhibit the absorbents of the whole body in one view. This could not be done from any one subject. No body would keep long enough, even in winter, to admit of the necessary injections, dissections, and drawings. We cannot here, as in dissecting, leave off when we please, and begin again at our leisure. It is almost impossible to inject the absorbents equally well in every part of one body. It was necessary therefore, in order to exhibit the absorbents of the whole body in one view, to take whatever had been successfully injected in a variety of bodies, and to combine them together.

With this view I drew the outline of the human body of the ordinary size. On the trunk of the body I also drew the outline of the principal viscera of the thorax and abdomen. The lymphatics were then put in their respective places, also of the natural size. When the whole was finished, the annexed figure was reduced to its present state, and the proportions every where accurately preserved. When the absorbents on the extremities are represented by continued lines, it is to be understood that they are then superficial; that is, immediately under the skin, on the extremities; and immediately under the peritoneum or pleura, or some analogous membrane, on the viscera. When they are represented by dotted lines, it is to be understood that they are on the posterior side on the extremities. In this I have not taken an unprecedented liberty with my subject: the great Albinus informs us, that he constructed his muscular figures precisely in the same way; that in the first place he procured a very fine natural skeleton, had very accurate drawings made of it, and then, from a variety of subjects, he placed the muscles on it in their relative situations: his words are, "Sic paratus, et consilio certiore, et spe minus dubia, ad musculos figuris sceleti inscribendos aggredi." And that it was even impossible for him to do this, but from a variety of bodies: "Non poteram certe, ex uno eodemque corpore, musculorum plerorumque figuras consequi, nedum omnium:

nium: imo vero satis apparebat, aliquot fore impendendos annos, corporaque adhibenda multa." He farther informs us, that he not only collected from a number of bodies, but that he selected what appeared to him the finest of its kind: "Corpora adhibita adultorum, eorumque quæ maxime erant idonea: musculi autem, quales frequentius occurrerant, tales exhibiti, potissimumque electi, quos absolutiores simul et laudatiores esse licebat existimare." I have done nearly the same thing with the lymphatics.—Dr. Hunter's trustees once proposed to have engraved and published all the drawings we had on this subject, and to have placed this figure the last; so that the reader, having seen the separate plates, each of which were taken from one body only, and are faithful copies of nature, might better judge of the degree of liberty I had taken in combining them into one; but the expence of engraving induced me to lay before the public what Dr. Hunter and I had done in the absorbent system in one view: and, if they are inclined to encourage the work, the different parts of which the figure is composed, will appear afterwards separately. Almost all the injections, from which the drawings were made, are still preserved in Windmill Street. The same vessels are never represented twice in the same limb, or on the same viscus; nor were more than two or three different drawings combined in any one part. The liver, for example, appears more crowded with lymphatics than any other part: the appearance, however, is produced from the combination of two preparations only, in which I had injected these vessels with quicksilver, and from which drawings were made at the time. No vessels are represented but such as I had injected with quicksilver: I have seen the foot covered with lymphatics, but I have drawn none but those I had injected.

I am sufficiently aware of the objections which will be made to this figure. Eustachius, Vieussens, and many of the celebrated anatomists, have previously employed this method; but Haller objects to the making the eye travel over an *inane album*, as he chooses to call it, *arteriarum*, *venarum*, *aut nervorum.* Nevertheless, I say, that though it is certainly true that vessels or nerves thus exhibited do not convey so good an idea as when shewn precisely in their situation, respecting parts more commonly known, yet it may give a very good general idea; and, as I have added the outline of the body and viscera also, it will do more than those figures which Haller complains of.

Since the former edition, chance has thrown in my way a body, in which the thoracic duct or trunk of the absorbent system was nearly as large as the aorta, and of which my assistant, Mr. Wilson, was able to show the right lower extremity covered with the absorbents he had injected with quicksilver; I have of course added some new engravings from these and other subjects.

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CHAP. I.

Of Absorption *generally.*

Absorption is a term derived from the Latin language, and signifies, literally, drinking up: Thus Pliny says of Cleopatra's contrivance to swallow £80,000 at a draught, "Regina meretrix detractum unionem mersit et liquefactum *absorbuit.*" And Horace uses it exactly in the same sense in the lines——"ut decies solidum *absorberet,* Aceto, diluit insignem baccam."—The Romans however employed this term to various other properties of inanimate matter, living vegetables, and animals, as we do now.

We say that inanimate fluid matter absorbs; for example, oil of vitriol absorbs moisture from the atmosphere, and in the space of a year becomes from this circumstance alone seven times heavier than at first.—We say that a sand stone absorbs water poured on it.—We explain the absorption by the oil of vitriol on the principle of chemical attraction, and the absorption of the sand stone is commonly ascribed to its *porosity* and consequent *attraction* of gravitation. Many have supposed that vegetables and animals absorbed on the same principle. Boyle speaks of *porositas animalium*; wonders that this property escaped my Lord Bacon, and thinks that had he turned his mind this way, he would have written an excellent

Porology, and that it would have been one of the finest things amongst his DESIDERATA.

Vegetables and animals absorb, however, in a different manner, and on an entirely different principle from inanimate matter; for as in the first sense of absorption they take in and propel forward.

This absorption in vegetables is performed by living and irritable vessels, and depends on the presence of a stimulus. Most plants absorb both by their roots and branches, some principally by their leaves; amongst the last is the CACTUS, the surface of whose stems have the properties of leaves.

This absorption in animals is a property in certain vessels of their bodies, by which they take up the fluids in which their orifices are immersed; and carry them into the blood vessels.

The beginning of absorption may or may not resemble the attraction of capillary vessels in dead matter, but the power of propelling the fluids depends on the living power of the vessels.

Dead animal matter quickly admits of the absorption from porosity, and allows itself to be pervaded by fluids, and we call this *soaking*, or *transudation.*

Dr. Hunter himself at one time believed that certain fluids in the living body got out of vessels by transudation; and that the fluid found on the surfaces of the different viscera, and in all the internal cavities, was formed by transudation of the thinner fluids through the coats of arteries; for he observed, that the arteries in the dead body, injected with water till they became quite turgid, in a very little time after became flaccid, having allowed the fluid, as he said, to soak through their sides into the cellular membrane.

Albinus appears to have entertained a similar opinion, and suspected that the perspired fluids oozed through the coats of the arteries in the skin. "Quid ni penetraret per mollia nostra humidaque, quum calentis aquæ va-"por per durum siccumque corium eo modo penetrat?" Professor Mekel, in the Memoirs of the Academy of Berlin, also maintains the doctrine of transudation through the cuticle. "Quoique inaccessible aux vaisseaux, "sa nature est pourtant telle qu'il transmet le liquide dont il est imbu, à-"peuprès comme pourroit le faire un cuir mince humecté."

Haller, in a number of places in his Physiology, admits a similar transudation of fluids; and says the oil soaks through the peritoneum, for example,

ple, or pleura, and assists in forming the lubricating fluid of these surfaces. He believes even that the vapour of the subjacent rectum penetrates through the *vesiculæ seminales*, and gives the peculiar odour to the semen.

I am sorry to oppose such respectable authority; but I am of a contrary opinion, and join with Dr. Fordyce in believing all parts of a living body impervious but by vessels, for the following reasons:—If fluids get out of vessels by transudation, they may get into them by the same means, and the first step, at least, in absorption, might thus depend on an animal porosity: but this, I am confident, is not true.

In dead bodies the fluids certainly transude: the vessels, in losing life, lose the property of confining their fluids. Wherever the contained fluid is sufficiently coloured, we can easily demonstrate this. Bile, for example, is either brown, yellow, or green; and blood of a dark red: the first transudes through the gall-bladder, and tinges the transverse arch of the colon, the duodenum, and pylorus, in short, all the neighbouring parts, of the same colour with itself; the second also transudes through the coats of veins, and makes the stomach, for example, which is naturally white in the living body, of a dark red. Thin fluids injected into the blood-vessels, in the dead body, also transude: glue dissolved in water, and thrown into the coronary veins, transudes into the cavity of the pericardium, and jellying retains the shape of that *sac*; the same glue injected into the veins of the pia mater, transudes into the ventricles of the brain, and when cold and jellied, retains the figure of these cavities: but nothing of this kind takes place in living bodies. Suppose the cavity of the abdomen, in a living animal, intentionally or accidentally laid open, none of the former examples of transudation will be observed; the bile will not be found transuding through its own capsule, nor tinging the colon or pylorus; the stomach will be seen perfectly white. Mr. Hunter's experiments on the blood-vessels of living animals, to be mentioned hereafter, prove that coloured fluids, injected into the veins of the intestines, neither escaped through orifices opening on surfaces, nor transuded through their coats. That the fluid found on surfaces, is not from transudation through the coats of arteries, I am persuaded, from attending to the following circumstances:—The sweat, or the fluid found on the surface of the body, and which comes more immediately under our observation, is found in greater quantity at one time than another. This increase of quantity is evidently connected with greater force in the heart and arteries, propelling the fluids, as we see after violent exercise. Now these facts correspond better with the theory which supposes organized orifices, or that the mouths of the exhalent arteries terminate on surfaces; for, as the force is greater which propels the fluids, these orifices must be in proportion distended; and the fluid being also propelled with greater velocity, we can easily conceive how the secretion should be encreased. On the other hand, that copious cold sweat which takes place on fainting, appears to depend on the greater relaxation of these exhalent orifices permitting the fluids to escape: but on the principle of transudation, which must suppose the fluid and filtre to be almost always in the same state, these phænomena are absolutely inexplicable.

That the oil is fluid in the living body, I allow; but that it transudes, I deny. It is contained in cells, from whence it cannot escape but by the mouths of absorbent vessels; accordingly, it cannot be squeezed from one part to another, but maintains invariably certain fixed situations in all bodies where it is to be found. Supposing oil capable of transuding in the living body, then it would follow that the most dependant parts of the body would ultimately contain it in the greatest quantity, as gravity would naturally lead it that way, unless the whole of those cells were so full of oily and watery fluids, that the lesser specific gravity of the oil should carry it to the top: another consequence would be, that no part of the body could possibly be exempt from oil. But as we know that neither of these circumstances are true, the transudation of oil becomes more than improbable. Haller, I observe, adduces, as a proof of the transudation of oil, the circumstance of its giving transparency to the surfaces of dead bones, and even appearing on these surfaces in a liquid form. But, besides that this is an instance in the dead body, Haller was not aware, that, in order to this transudation, which I allow, some circumstances are necessary, which can never exist in the living body: in the first place, the cells containing the fat must be previously broke down by putrefaction; secondly, the watery fluids must evaporate, and the bones become dry.

That there is no transudation through the cuticle, I am perfectly certain.

Vesications from burns or blisters afford us an opportunity of being convinced of this fact. The fluid may sometimes be absorbed by the vessels on the surface of the skin, and may thus be suspected to have transuded through the cuticle; but more commonly it remains days or weeks, or till it is let out by the surgeon's scissars. Even in the dead body, where transudation of watery fluids so generally takes place, there is no transudation through the cuticle. I have kept a portion of the dead body, covered with the skin and cuticle, before the fire, for six weeks together; it was as little dried as the first moment it was placed there; whereas, in one hour, had the cuticle been removed, the skin would have become hard, transparent, and horny. In short, the intention of nature is just the reverse of what Galen and Professor Mekel imagine: it is to prevent the evaporation of such fluids as are in the cellular membrane, and are immediately in contact with the cuticle; for if these evaporate, the cells of the cellular membrane communicating freely with one another all over the body, they would be succeeded by fluids behind, and thus an immense waste of fluids would take place. For the same reason, Nature covers oranges, lemons, and fruit in general, with an analogous membrane: it is equally fine, and has this property at least of the human cuticle, of preventing transudation of cellular fluids. Every one may convince himself of this fact: by removing this membrane, the fluids quickly evaporate, and the fruit becomes shrivelled and dried. In short, nothing appears to me more evident than this fact, that in the living body there is no transudation of watery fluids: could it take place, there would be no such disease as a preternatural collection of fluid in any cavity, no such disease as dropsy; for the fluids transuding through membranes and cuticle, must pass from one cavity into another; from the thorax, in the *hydrops pectoris*, into the subjacent abdomen, and having there formed *ascites*, would soon transude and form *œdema* of the lower extremities, where, likewise, after some little time, it would transude through the cuticle, and these diseases would naturally cure themselves at last. But every body knows, that water may remain long collected in the chest, without producing dropsy of the belly; and this last I have known exist years, without producing swellings of the legs. When swellings of the legs have taken place, I have seen the cutis distended, and shining, and hard, for many weeks, without the least mark of transudation; nor did the swelling subside till the cuticle was separated, till it burst, or was punctured.

As I do not admit of the transudation of watery fluids during life, neither do I allow of the penetration, pervading, or transudation of such fluids as, on opening the cavities of the body, emit vapour, and are sometimes odorous and fetid. The muscles covering the abdomen become sooner green, sooner putrid, than other muscles in the body; and this, with reason, has been suspected to arise from their lying immediately over the intestines, then commonly filled with putrid fluids, or fetid and volatile vapour; both of which may transude after death, and become the cause of this so much more accelerated putrefaction of these muscles. But nothing like this takes place in the living body; no fetid vapour of the intestines can thus ever enter the blood-vessels, or pervade the other parts of the body, while life remains: the highly fetid fluid of a lumber abscess is neither sensible to the patient nor the by-standers, till it is opened; the odour of the semen is its own peculiar odour, and not, as Haller imagines, from the fetid air of the rectum pervading the *vesiculæ seminales:* nor can I admit, that the peculiar flavour and toughness of bull's flesh, wholly wanting in that of the calf or bullock, arises from the odour of the semen pervading the whole body. There is not the least resemblance between the two odours, nor can one possibly conceive any affinity between odorous particles in a confined fluid, and rigidity and tenacity in muscular fibres. Transudation, then, does not take place in living bodies; and transudation, and even the commencement of absorption, are perfectly distinct.

CHAP. II.

The Ancients seem to have known something of the Property of absorbing in Human Bodies.

THAT the human body inhaled, was the doctrine both of Hippocrates and Galen.

Hippocrates taught, that an inhalation of vapour and fluid took place on the surface of the body, as well as an exhalation of similar matter. He asserted the same thing of all the internal surfaces and cavities: we find this doctrine summed up in the following words:

" Σαρκες ὁλκοὶ καὶ εκ κοιλίης καὶ ἔξωθεν· δῆλον ἡ ἀισθησις ως εκπνοον καὶ εισπνοον ὅλον
" τὸ σωμα."

" The soft parts of the body attract matter to themselves both from within and from without; a proof that the whole body exhales and inhales."

One might suppose that Hippocrates here only meant, by exhaling and inhaling, expiration and inspiration from the lungs: but he says, ὅλον τὸ σωμα, which can never apply to the lungs; and Galen, as we shall see afterwards, understands the word εισπνοον, here used by Hippocrates, as signifying absorption. Passages in Hippocrates, to be hereafter quoted, will also put this matter beyond all doubt. Galen himself speaks most decisively of the absorption in the human body; he, indeed, conceives it to be by an attraction; but he uses the same word when he describes the veins taking up fluids. His words are:

" Δύο εισιν ὁλκῆς ἔιδη τὸ μεν τῆ πρὸς το κενοὺμενον ἀκολουθὶα το δε ὀικειότητι ποὶοτητὸς
" γιγνὸμενον. ἑτέρως μὲν γὰρ εις τας φὺσας ὁ ἀήρ ετερως δέ ὁ σὶδηρος απο της ηρακλειας
" επισπᾶται λίθου."——That is,

" There are two kinds of attraction; one which arises in consequence
" of a *vacuum* being formed, and the other from affinity in quality; for,
" in one way does the bellows attract air; and in another way is steel
" attracted by the magnet."

The Arabian physicians appear also to have been acquainted with this property of absorbing in the human body; for we find them frequently applying medicines to the surface of the skin, which were to produce their effects as expectorants on the lungs, as emetics on the stomach, as purgatives on the intestines, or diuretics on the kidneys. It may here be urged, that this is no proof of their knowing any thing of absorption. The Chinese physicians, Kempher informs us, frequently apply remedies to one part of the surface of the body, which are intended to produce their effects on a distant one; but this depends on a different principle from absorption. They have conceived established connections between some parts of the body and certain others; and when they wish to produce an effect on a diseased eye, for example, they apply the remedy not to the eye itself, but to some distant part of the body, with which it is particularly connected. As the Greeks, however, appear to have understood absorption, and as the Arabians obtained their medical knowledge from them, it becomes much more probable that the practice mentioned was founded either on a knowledge or belief of the absorbing property of the human body; besides, Avenzoar, one of their physicians, actually proposes in the stricture of the œsophagus (a disease he first described) to put his patients into baths of milk, or other nutritious fluids, to sustain life by the absorption of those fluids through the pores of the skin, till he should have time to overcome the stricture.

CHAP. III.

The Ancients also maintained, that the Inhalation in the Human Body was performed by Vessels.

HIPPOCRATES and Galen not only asserted, that all parts of the body inhaled, they also taught that this inhalation was performed by vessels; that both veins and arteries inhaled.

Hippocrates says, Ελκει μεν γὰρ το σωμα απο των βρωματῶν και ποτῶν ες τὴν κοιλιην—η ομοίη ἰκμας την ομοιην δια των φλεβων: " For the body absorbs from " the meats and drinks in the stomach—similar fluid attracting similar, " through the medium of the veins." And in another place still more particular, leaves not the least room to doubt his meaning, Καὶ γαρ αἱ φλεβες, αἱ εκ της νηδυος, καὶ των εντερων, ἐις ἃ ξυλλεγεται τα σιτια, και τα ποτα, επειδὰν θερμανθῆ ταῦτα, ελκȣσι το λεπτοτατον, καὶ το υγρὸτατον, το δε παχυτατον αυτȣ καταλέιπεται, καὶ γινεται κοπρος, εν τοῖσιν εντεροισι τοισι κατω.——

" For the veins of the stomach and intestines, in which our meat and " drink are collected, as soon as these are heated (digested) attract the " thinnest and most liquid part; but the thickest part is left, and becomes " *fæces* in the lower part of the intestines."

In another place he recommends, after vomiting, the washing the mouth with some acid wine, in order that the mouths of the veins might be constricted, and thus might not take in any of the vomit:

Εκ δε τȣ ἐμέτȣ κλύσαι τὸ ϛόμα καὶ την φάρυγγα οινω αύϛηρῶ, ὅκως αν συϛυφῆ τα ϛοματα των φλεϐῶν καὶ μηδεν επικατασπασθῆ ὁκοῖα γίνεται απο ἐμέτων.

In the same manner Galen ascribes the absorption on the surface of the body to veins:

Ὡσπερ, διὰ των εις το δερμα περαὶνομενων ϛομὰτων ἐκρίνȣσι μὲν ἔξω πᾶν ὅσον ἀτμῶδες καὶ καπνωδες περιτωμα, μεταλαμϐάνȣσι δε εις εαυτας εκ τȣ περιεχοντος ἡμᾶς ἀέρος ȣκ ολιγην μοῖραν. καὶ τȣτ’ ἔϛι το ϖρος Ιπποκρατȣς λεγομενον ως εκπνȣν καὶ εισπνȣν εϛιν ὅλον το σῶμα.——

"For as the veins, by mouths placed in the skin, throw out whatever is "redundant of vapour or smoke; so they receive, by the same mouths, "no small quantity from the surrounding air; and this is what Hippocrates "means, when he says, that the whole body exhales and inhales."

It also appears from Galen, that the ancients believed that the arteries absorbed as well as the veins; for he says:

Ατμον μεν οῦν ἒχȣσαι καὶ πνεῦμα καὶ λεπτον αἷμα κατα ταις διαστάσεις ἕλκειν αἱ ἀρτηρὶαι τον κατα τὴν κοιλὶαν καὶ τα ἔντερα περιεχομενον χυμὸν, ἢ ουδε ὅλως η παντaπασι συνεπισπῶνται ϐραχὺ.

"The arteries, which contain vapour, in their diastole attract (absorb) "air, and the more subtile part of the blood; but they do not at all ab"sorb the fluid found in the stomach and intestines, or but very little."

Mr. Boyle, whose doctrines Haller thinks important on this subject, describes the porosity and absorption of dead matter, and though he does not absolutely reject the perforations made by the extremities of excretory vessels in the skin, described, as he says, by Steno and Malpighi, yet he seems to have known nothing of the absorbing orifices of veins, as described by Hippocrates and Galen, much less had he any idea of the really existing orifices of lacteals and lymphatics.

CHAP. IV.

Experiments instituted by the Moderns, with a View to demonstrate the Venous Absorption of the Ancients.

I Do not know that the ancients made any experiments which could induce them to believe that veins absorbed, nor do I know on what foundation their belief rested. There is one experiment of Erasistratus's, mentioned by Galen, which appears to have given rise to their doctrine of the arteries absorbing air and finer fluids: perhaps this might induce them to suspect that the veins too absorbed. It will appear afterwards, that Erasistratus was, in that experiment, deceived; that they were not arteries, but lacteals, which he saw; and that it was not air, but chyle, which they had absorbed; of course, that there was no just reason for the doctrine of arterial absorption. The discovery of the circulation of the blood demonstrated that the course of the arterial fluids was constantly from the centre of the body to the circumference, that is, perfectly opposite to that of absorbed fluids, or such as are supposed to be passing from the circumference to the centre; and this overturned entirely that doctrine. That they were equally mistaken in asserting the absorption by red veins, has not been so universally assented to. Swammerdam first made experiments to prove their doctrine true; he made ligatures on the mesenteric veins, and having thus intercepted the blood returning from the intestines, after waiting some time, he opened the veins, and examined the blood: it appeared to him marked with white lines or points, which he concluded was the chyle which the veins had just absorbed from the surface of the intestines: "Sanguis quandoque velut striatus, et albis lineis permistus, quandoque seu punctis notatus ipsi apparebat:" And though he knew that there was also a white fluid in the lacteals, he would not allow that it was the chyle, but a white lymph which these vessels took up from the glands of the intestines: "Ideoque in ea sum sententia, non nisi albicantem lympham esse, quicquid in lacteis vidimus, et ex glandulis intestinorum procedit, quæ succum suum ab arteriis accipiunt."—Kaaw Boerhaave, Professor of Medicine at Petersburgh, and a great admirer of the ancients, informs us, in his book entitled *Perspiratio dicta Hippocratis*, that he injected water into the stomach and intestines of a dead dog, and saw it return by the veins of those parts, in such quantity as to wash out the blood they contained, and leave them perfectly white: "Canis post mortem statim incidi et aperui thoracem et abdomen; mox per œsophagum, premendo leniter ventriculum, evomere contenta omnia feci. Dein immissam puram aquam tepidam, movendo lenissime ventriculum, vidi a venulis bibulis illam resorberi, ingredi venas gastricas majores, tandem portarum venæ tradi, et ex hac, per hepar, venæ cavæ reddi eandem.—Tædioso labore, per horas lenissime immittere aquam et premere ventriculum continuavi, donec pallerent omnia vasa sanguine orbata, per resorptam aquam.—Aqua vel cera, per hæmorrhoidales venas injecta, in intestinorum cava exit."

Professor Mekel of Berlin also supported this doctrine; and in his treatise, entitled, *Experimenta nova et Observationes de Finibus Venarum*, &c. asserts, that the veins open on surfaces, in the human body; particularly, that he had injected the veins by coloured wax thrown into the cavities of the *vesiculæ seminales*; that he had also injected the veins by air and water thrown into the cavity of the bladder of urine from the urethra: "Viri robusti vesiculas seminales, adhuc in pelvi, inter vesicam urinariam et intestinum rectum sitas, absque ulla reliquorum vasorum liquida ferentium repletione, per ductum deferentem, ea intentione, ceraceo liquido subtiliori, rubro colore tincto, replevi, ut situm ac figuram earundem naturalem, hocce præparato, in physiologicis meis lectionibus, cuilibet tempore opportuno, monstrare possem. Ne vero in urethram ac vesicam urinariam injectum liquidum prorumperet, frustraretque exspectationem meam, tubulos ejaculatorios caute ligavi. Distentis itaque liquido vesiculis, id quod in aqua tepida perfeci, ne injectio nimis cito coagularetur, venæ hypogastricæ ramos, plexum venarum vesiculas seminales circumdantem formantes, ad majores usque ramos injectione replevi, eamque ex truncis dissectis effluere inexspectato sane spectaculo vidi. Refrigeratis itaque partibus, nil avidius experiri cupiebam, quam quæ hujus singularis phænomeni causa exstiterit. Caute itaque præparatis venis, ad externam vesicularum seminalium superficiem,

ficiem, usque eas plexu minimarum venarum, injectione ceracea rubra turgidarum, ubique tectas inveni, quarum extremitates in cavum vesicularum canalem defixæ hærebant.—Repetitum hoc experimentum non semper mihi successit, sed pluries tamen, periculo in hoc receptaculo seminis per injectionem facto, eventus idem labori respondit.

"In cadavere virili satis robusto, urinæ vias indagaturas, vesicam per urethram inflare conatus, omnis flatus per venas continuo ex vesicæ cavo rediit, ut vesica inflata mox iterum collaberetur. Studiosius in causam hujusmodi phænomeni inquirens, aquam in vesicam per urethram siphonis ope impuli, quæ vero facillime ex vesica in venas plexum vescæ formantes, et ex his in truuncum venæ hypogastricæ, transiit. Interne considerata vesica, nullo villosæ tunicæ vitio laboravit, sed integerrima ac naturaliter constituta fuit, ut itaque viam ex vesica urinaria, fluido vel aeri apertam, per vasorum venosorum ostiola patuisse nullum dubium sit. In aliis, inflando aerem itidem, sed lentius, per vasa ex vesicæ cavo viam sibi in venas quæsivisse repetitis vicibus observavi." The same author informs us, that he saw a white fluid in the veins of the intestines in the dead body: "Lympha alba in venis mesenterii."

Baron Haller is also of the same opinion, and strenuously contends, that the veins certainly arise from surfaces by open mouths, and must be absorbents, as the ancients asserted.

"Neque raro vidi," says he, "cæruleam ichthyocolam, quæ de venis exhalaverat, pericardii figuram expressisse. Et interum figuram ventriculorum cerebri glutino piscium per venas impulso, non semel conservatam vidi, ut manifestum sit, a venis in eas omnes caveas liberum iter esse."

Leiberkun asserts, that he saw the injection run out of the orifices of the veins on the villi of the intestines.

Arguments have been added to these experiments. It has been urged, that veins are confessedly allowed, by every anatomist, to arise by open mouths from the cells of the *corpus spongiosum urethræ* and *glans penis*, from similar cells in the *clitoris* and *plexus retiformis* in women, as well as from the cells of the *placenta.* The same thing is seen in the spleen of many quadrupeds. The ingenious Boerhaave has also employed two other arguments in support of venal absorption in the intestinal tube: in the first place, he asserts that the blood of these veins, on standing, and in the dead body, either forms no coagulum at all, or a very small one; it would have coagulated in the arteries: it must have received some addition, some mixture must have taken place in the cavity of the veins, to have thus deprived it of its usual property. Secondly, he adduces the superior size and capacity of the mesenteric veins, when compared with their corresponding arteries, as a strong argument in favour of their absorbing from the intestines. Why are they so much larger, double, triple the size of the arteries, if they are not to contain something else than blood brought to them by these arteries, especially when the whole of the arterial blood does not come to them, as part is carried into the intestines in form of a secretion?

The bile, others say, seen in the duodenum, is secreted in vast quantity, more than can possibly pass off with the fæces, but this bile is not found in the lacteals tinging the chyle; what becomes of it? Boerhaave himself was inclined to believe, that, after having served certain purposes in the alimentary canal, the greatest part of it was absorbed by the veins, and carried back to the liver; and that the bile thus underwent, like the blood, a circulation of its own.

CHAP. V.

Experiments demonstrating that red Veins do not absorb.

In consequence of his great attention to the lacteals and lymphatics, and to anatomical injections in general, Dr. Hunter began very early to doubt of the absorption by red veins: He says,

" My only doubt was, whether the veins did or did not absorb a certain " quantity, especially in the intestines.—From my own observations on in- " jections, I should have concluded they did not, and that there was no " passage for liquors between an intestine and the mesenteric veins, other- " wise than by transudation. But authors of the best credit had given "such arguments and experiments, that I dared not, even in my own "mind, determine the question."

He does not appear to have been acquainted with the experiments of Thomas Bartholin, one of the first discoverers of the lymphatics. I find that he had made experiments on the veins of the intestines, in living animals, which disproved venal absorption there, and made him totally reject it. In the epistle in which he finds fault with Harvey for refusing to admit the existence of the lacteals, he says: "Chylus non potest venas meseriacas ingredi, quia nunquam id visum, nunquam voluit natura, nusquam patet aditus: reverò non intrare hoc experimentum probat. Si ligatus sit mesentericus ramus, non impeditur chylus, quominus ad lacteas sensim inde intumentes transeat. At, ligatis lacteis, restitat chylus, nec ex ventriculo, aut intestinis, aut lactearum osculis, ulterius progreditur."

Mr. John Hunter positively denied the absorption by red veins, and made a number of experiments on living animals, which, in my opinion, are perfectly conclusive: as they are published in his brother's Medical Commentáries, I shall only give the result.

I observe, in general, that these experiments were made on the intestines and mesentery of five different animals; several experiments were frequently made in different parts of the intestinal tube, in each animal, at the same time. It has been doubted, whether any experiment, which puts an animal to pain, can be depended on; but there cannot be a doubt of their decisive nature here, for, as the opening the abdomen, wounding the intestines, and making ligatures on them, did not hinder, in the smallest degree, the lacteals from performing their functions, nor the arteries and veins from circulating the blood, not a shadow of a reason can be given, why the veins should not have absorbed, supposing them capable of this office.

1st. After one of the animals had been properly secured, and the abdomen opened, portions of the intestines were quickly emptied, by pressure, of their proper contents, and warm milk was injected in their place, and confined by ligatures. The veins belonging to these portions of intestines were emptied of their blood, by punctures made in their trunks, and prevented from receiving more blood, by ligatures made on the trunks of their corresponding arteries. In this state, the parts were returned into the abdomen; and, by the veins being thus left empty, even a small absorption of the milk would have been detected, as the coats of the veins are so thin, that they would have permitted a white fluid to appear through their sides as readily as red blood; whereas, had the blood been allowed to circulate through the veins, a small absorption of milk might not, perhaps, be perceived, as mixing with much circulating red fluid.* The parts having remained in the abdomen a quarter of an hour, half an hour, or more, that the natural warmth of the cavity might assist the natural absorption, they were again allowed to protrude, and carefully examined: the veins were found nearly as empty as when the parts were first returned, and contained not one drop of white fluid; but the lacteals were full of it.

2d. Similar experiments were made on other animals, with this additional circumstance, that pressure was made on the portions of intestines containing the milk. Kaaw Boerhave imagined, that he forwarded the absorption of water, into the veins of the stomach, by pressure. Alternate and considerable pressure was here made, even to that degree, that at last the intestines burst; and yet not a drop of the milk was found in the veins.

3d. It might be objected, that the veins did not absorb, because ligatures were made on their trunks: this could be no objection, for the lacteals persist in absorbing under similar circumstances. However, that even the shadow of an objection might be removed, similar experiments to the former were made, where the arteries and veins were left free, and the blood continued to circulate, during the whole period. After the parts had continued a quarter of an hour in the cavity of the abdomen, they were allowed to protrude again; openings were made in the trunks of the veins, and the blood received in vessels; but neither the fluid blood, nor the serum, after the blood had coagulated, shewed the least mixture of milk.

4th. Similar experiments were made with starch dissolved in water, and coloured blue with indigo. The fluid venal blood did not appear darker in colour; nor did the serum of the same blood, after it had coagulated, shew the least tinge of blue.

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* Though I have supposed that a white fluid, mixed with the blood, might not be easily detected, yet, in fact, the admixture of the chyle, in the left subclavian vein, is easily perceived, and any degree of milkiness in the serum of coagulated blood readily discovered by an accustomed eye.

5th. One cannot consider milk, and starch dissolved in water, as viscid fluids, not easily absorbed by veins; for the lacteals absorbed them very readily. In Kaaw Boerhaave's experiments, the veins, however, absorbed water. Here too a portion of intestine, emptied previously, was filled with warm water, the trunk of the arteries was tied, yet the corresponding veins never became fuller, nor was there the least appearance of the water having got into the veins.

6th. The eye might be deceived; the smell, perhaps, might detect what had eluded the other sense: similar experiments were therefore made, in the intestines of other animals, with a solution of musk in water. After a proper period, the venous blood was received into a cup, *per saltum*, from an opening made in the trunk of the veins; but it discovered not the least smell of musk!

7th. While portions of the intestines were full of the starch, coloured with indigo, warm milk was injected by the trunk of the arteries till it returned by the veins, and this injection was continued for some considerable time: this milk, received from an opening in the trunk of the veins, shewed not the least tinge of blue.

8th. Portions of the intestines were emptied, and by ligatures separated from the general canal; milk was injected by the trunk of the veins, which here have no valves, till it returned by the arteries: the intestines, after a continuation of this injection for a considerable time, were, on examination, found quite empty.

9th. After one of the animals was dead, the mesenteric veins were inflated with air, which, though a very viscid fluid, found its way into the cavity of the intestines; though milk, injected through the same veins, while the animal was alive, could not be forced into the same cavity.

These experiments appear to me perfectly conclusive. Haller says of them, "Videntur suadere, ab intestinis in lactea vasa patulam viam esse, non perinde in venas mesentericas;" and a little after adds, "Multum tribuo Cl. Viri experimentis, in quibus candor cum industria conjungatur. Sed contrarii alia numerosa argumenta habemus ut non possim a præceptoris

(Boerhaave) sententia recedere." He also says, that where experiments are directly opposite, on the same subject, he was wont to believe those which affirmed any fact, rather than those which denied it; and his reason for doing so is, "facilius enim experimento successus a casu aliquo negatur: successu vero demonstrato non facile causa alia ejus eventus, invenitur, quam ipsa partium fabrica." How far he reasons well, we shall see in the sequel.—Leiberkun's experiments were on the dead body, where transudation takes place, and are therefore inconclusive.

As to Boerhaave's observations, already mentioned, it is not true, that the blood of these veins does not coagulate: in experiments made on living animals, whose vena portarum is in every respect similar to the same vein in the human body, I have always seen it coagulate; nor can I conceive how this error should have become so generally believed. Again, what could these veins absorb from the intestines, which would prevent their blood from coagulating? The chyle could have no such effect; the lymph could not do this; these are coagulating fluids themselves, and would rather increase than diminish the crassamentum of the blood. The arguments in favour of the bile being absorbed by the veins, in order to undergo a circulation through the liver, are weak and inconclusive. The quantity, it is said, is very considerable: What becomes of it? It may be decomposed in the intestines, and may then enter into the composition of the chyle; or, it may be contained in, or form a part of the feces.—The serum of the blood of the veins of the intestines, is not bitter to the taste, is neither usually tinged green, brown, or yellow, nor capable of tinging linen so, as the urine does in jaundice, when we know that it certainly contains bile. The next argument adduced by Boerhaave, is founded on the superior size of these veins to their corresponding arteries—Why are the veins so much larger, double, or triple the size of the arteries, when they are not even to carry back the whole blood of the arteries; for part of this goes off, by secretion, into the intestines? To this it may be replied, that the appearance of the veins in the dead body proves nothing respecting their relative size in the living body: almost the whole blood of the body is then accumulated in them; they contain not only their own proportion of blood, but that also which was contained in the arteries. In the next place, the blood in the veins, in the living body, is subject to frequent retardation, on sneezing, coughing, straining, or any great effort; and they are thus much dilated beyond what they were originally. If they had not been larger, these retardations would have more frequently ruptured them. Besides, the quantity of the blood in the veins is liable to greater variation than it is in the arteries. The cutaneous veins are turgid in summer, and almost totally contracted in winter, so that in many cases they do not contain the twenty-fifth part of blood in the one season as they do in the other. The velocity of the arterial blood being greater than that of the venous*, it was also necessary, on that account, that the veins should be larger, even without any supposed absorption of fluids by them; therefore the red veins of the intestines, and mesentery of quadrupeds, do not absorb, and every thing we have observed in the corresponding parts, in the human body, lead us to the same conclusions. The lacteals have been repeatedly seen turgid with chyle, in the intestines and mesentery of the human body; but I never saw, on such occasions, the least mixture of chyle, or tinge of white fluid, in the blood of the mesenteric veins. I mentioned, in the last chapter, Swammerdam's having seen the blood in the mesenteric veins streaked white. I also mentioned, that Professor Mekel informed us, that he had seen white lymph in the same veins. I have frequently seen this appearance in the veins of the intestines: what this is owing to, I do not know; it cannot be absorption of chyle from the cavity of the intestines, for then the lacteals would also be found to contain the same coloured fluid: but, on every occasion, where I have seen this appearance in the veins, the lacteals were constantly empty. When blood has been taken from the veins of the arm, the serum has been found frequently white as milk. It has continued in this state for months, in the same patient; and at last recovered its natural colour, without our being able to assign any good reason for the one change, or for the other. Some hours after a full meal, blood, taken from the veins of the arm, has appeared streaked with white lines, which we know is from the chyle, which was poured into them by the thoracic duct; but is no proof of these veins having absorbed chyle from the intestines. As the red veins then do not absorb in the intestines, it is not probable, nor does it appear, that they absorb any where else. The appearances which Kaaw Boerhaave saw, after injecting water into the stomach and intestines of dogs, were owing entirely to transudation. In the injection of the veins from the vesiculæ seminales, by Professor Mekel, there must have been rupture of the coats of the veins in some place or other; for though I have fifty times, at least, injected the vesiculæ seminales with quicksilver, a more penetrating fluid than melted wax, I never once met with the same appearance: besides, if injections find their way from cavities into the supposed mouths of veins, they should also have found their way into the orifices of the lymphatics, which here were not injected. But injections thrown into the intestines, or other cavities, in the dead body, never, that I could observe, get into the lacteals, or lymphatics, though we know their orifices to be really there: could this have taken place, all the absorbent system would long ago have been compleatly described. As to the injection of the veins from the cavity of the bladder, by the same anatomist, I can account for that appearance in another way, and perfectly satisfactorily. The lacunæ of the urethra, or the excretory ducts of glands opening on that surface, are continued a little way into the cavity of the bladder itself, where they are still more delicate in their texture, and are easily ruptured, when inflated with air, or injected with quicksilver. I have injected the veins of the bladder repeatedly from these lacunæ; and a paper from Mr. Watson is published by the Royal Society, on these very lacunæ, where the author supposes them to be the orifices of lymphatics; and says, that he introduced bristles into them:—when they are ruptured, the veins, arteries, and absorbents are tore at the same time; but the injection gets into the veins, as the larger vessels. The appearances observed by Haller, in injecting the dead body, are also certainly to be referred either to transudation, which so readily takes place in the dead body, or to the veins communicating with the extremities of the arteries, and the injections passing off by the then relaxed exhalents. Lymphatics inflame, when they absorb poisons, such as the venereal virus, cancerous matter, or the poison of the mad dog. Wounds received, both by myself and others, in dissecting dead bodies, have given me many opportunities of seeing these vessels inflamed, from an irritating matter they had absorbed from such wound. Now, as I never, on such occasion, found the veins inflamed, it is reasonable to infer they do not absorb these poisons, or irritating matter; and if they do not absorb on the intestines, nor on the surface of the body, nor from wounds, that they absorb no where else. As patients are frequently infected with the venereal virus, without its having previously inflamed any lymphatic gland, this circumstance may be considered by some as a proof of venous absorption; but it is not: all that it proves is, that the poison sometimes is not able to inflame the glands, or that they are sometimes less irritable, and not easily inflamed. That veins absorb in the placenta, because lymphatics have not yet been found there, is no good argument. Lymphatics have been found in parts formerly suspected to have none; and in whole classes of animals, where it was said they did not exist: and the analogy is on the side of their being there; for if the Author of Nature found the lymphatics necessary in all other parts, and if we are daily discovering more, then it is most probable that they exist in the placenta too, though they have not yet been found.

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* By Dr. Hales' experiments, the force of the motion in the arteries to that in the veins, is as sixteen to one, nearly.

When I said that there might be lymphatics in the placenta, it was the child's portion that I alluded to. Dr. Hunter believed that lymphatics existed here, similar to those Lister asserted he saw in the intestines, and mesentery of birds, " de avibus fatetur Listerus brevia esse, et in venas finiri "—Haller. I know there are lymphatics in the mother's part; but there the veins also arise by open mouths, out of cells, and the blood contained in these cells enters these mouths, and mingles with the circulating blood. This, according to some, is clearly venous absorption: the structure of the corpora cavernosa, penis, and clitoris, seems a good deal to resemble that of the mother's part of the placenta; and the veins appear to arise from cells there too. That the blood gets into these veins, from those cells, I do not doubt; but I used to explain this as circulation of the blood, not absorption, in the way Harvey conceived it to be, in the other parts of the body, nearly; that is, he conceived the blood to be thrown from the arteries into a parenchyma, or spungy texture, interposed between the ends of arteries and beginning of veins; and that the vis a tergo, in the arterial blood, propelled it not only through the spunge, but into the veins. Dr. Fordyce says, there must be something else in the structure of these parts, not yet understood; and rejects not only the solution I have given, of the passage of blood into veins, but denies the possibility of venous absorption any where, on the principles of hydrostatics, independant of the other arguments I have given. Supposing, says he, an opening made in a vein, there is a pressure equal to the force of the circulation in the veins, to force the blood out at this opening; it would therefore flow out, and remain out, unless there was a force superior to this pressure to throw it in again: but we know of no such force existing in the veins of the common structure. Nor is it possible that the vis a tergo, alleged by Harvey, can produce the supposed effects; for the cells of the supposed parenchyma, of the placenta, and corpora cavernosa, mentioned, are not tense at the time of the venous absorption, as it has been called. We know of no force in cavities capable of overcoming the pressure of the venous blood on the sides of the vessels, and of propelling fluids into their supposed open extremities; though we can easily conceive the muscular force of the lymphatics overcoming this pressure, in the angles between the jugulars and subclavians, for reasons which will be mentioned afterwards.

But the supporters of venous absorption will perhaps still contend that I have concluded too hastily, respecting the impossibility of its existence; and that there are, after all, arguments in its favour, which are unanswerable. From the history of the human body, it will appear, say they, that more fluids have been absorbed in a given time, from the cavity of the intestines, than the lacteals could be supposed capable of taking up, or the thoracic duct, consistent with its diameter, or any probable velocity of the absorbed fluids, could possibly transmit. The diameter of the thoracic duct, in the middle of the back, says Haller, is not more than a line, or the tenth part of an inch; and it transmits not only the chyle, but all the lymph of the lower extremities, of the contents of the pelvis, and of the cavity and parietes of the abdomen. Now Boerhaave mentions a man who drank sixteen pints of wine daily; Haller gives examples of patients drinking 200 ounces of mineral waters in a few hours; but almost the whole of these fluids were soon after returned by urine, which they could not have been, unless they had got into the blood by some other way than by the lacteals and the thoracic duct: but we know, from experiment, that the quantity of fluid fixed on will easily pass through a tube of a tenth part of an inch in diameter, in any of the periods assigned, though no other force be applied than that commonly exerted in throwing water through a syringe. As to the velocity of the absorbed fluids, there are very strong reasons for believing it to be different at different times. No man can tell why the absorbents should have their orifices immersed in the fluid of ascites for months or years, without taking up any sensible part of it; and why, on some stimulus from the constitution, they should remove it in three days: this, however, has sometimes happened; it happened to one of Dr. Hunter's medical friends, as he informed us at lectures; and it has happened to others. The chyle in the lacteals of the mesentery of dogs, in some of my experiments, evidently run through a space of four inches in a second, which is 20 feet in a minute: I have at other times seen the absorbed fluids vanish with almost incredible velocity: so that little can be concluded on, against the possibility of the fluids mentioned being absorbed by the lacteals, or transmitted by the thoracic duct, within the assigned periods. The diameter of the thoracic duct, in the middle of the back, where it is narrowest, is very often double that which Haller has fixed on. Sometimes there are two thoracic ducts, with separate insertions into the veins. There is constantly a trunk in the anterior mediastinum, under the sternum, as large as the thoracic duct itself, which is sometimes inserted into the termination of the thoracic duct, sometimes into the trunk of the absorbents of the right ride, and which I have seen transmitting the chyle.—Ruysch has supplied the supporters of absorption by red veins with another argument. He asserts, that the lymphatic glands, on the mesenteries of old people, are almost entirely obliterated; and, as he believed that all the lacteals went to those glands, if they disappeared, the lacteals must also be obliterated or obstructed: but, as old people frequently enjoy, under such circumstances, very good health, he could not help believing, that in them the red veins of the intestines performed the office of the lacteals. His words are: " Nam in spatio meseræi, palmam manus æquante, duas (glandulas) tantum reperiebam, aut tres, semine cannabino vix majores. Atque hoc ipsum phænomenon occurrit mihi sæpius in mesenteriis valde annosarum anicularum——Contra vero aperienti cadavera eorum qui in flore ætatis occubuerant, apparuit mesenterium refertum tanta glandularum copia, ut in portione ejus palmæ manus æquali, sexaginta vel septuaginta glandulas invenerim."—From these circumstances he is disposed to draw the following inference: "Sed quid tum chylo contigit qui solebat prius per venas lacteas deferri ad has in mesenterio glandulas, certos et necessarios in usus? Ibitne forsitan ille jam per venulas mesentericas exiguas et intestinorum cavis absorptus in ipsum hepar?" Haller says, "Dudum se absque lacteis vivere Ruyschius solebat dicere."

To this argument I reply, that all the solids shrink in old people; some, however, in a greater proportion than others, as we see in the breasts of women. It cannot be denied, the glands of the mesentery are exceedingly small in old people; but it does not necessarily follow, that they are entirely obstructed. I have sometimes seen the lacteals full of chyle in old people. Haller says, that he has frequently seen the thoracic duct full of chyle, in those who had passed the 70th year of their age: "In senibus," says he, "non raro, ductum thoracicum chylo albo plenum reperiissem." This could not have happened, if the lacteals had been totally obstructed; as the mesenteric veins do not lead to that duct, nor has it any other species of vessel coming to it from the mesentery.—In the last place, it has been said, that animals have not died so quickly as they should have done, when the thoracic duct was either tied, tore through, or obstructed, supposing it to be the only road by which the chyle could get into the blood. From an experiment of Duverney's, related in the Memoirs of the Academy of Sciences, it appears that a dog lived fifteen days after the veins, into which the thoracic duct is inserted, were tied up. Bartholin mentions a case where the thoracic duct was wounded, where, notwithstanding, the patient lived a considerable time. His words are, "longa fuit tabes." Mr. Cheston, of Gloucester, some years ago, shewed us in London the thoracic duct from the human subject, totally obstructed with a solid substance, which had every appearance of having remained there for a long time.——Allowing those arguments their full force, they by no means prove that the lymphatics or lacteals did not carry nutritious matter into the blood-vessels. The thoracic duct is frequently double; and has one insertion into the right subclavian vein, and another into the left. The older anatomists were not aware of this, and in their experiments tied up only the left subclavian and jugular veins. Besides the trunk already mentioned, in the anterior mediastinum, under the sternum, though often inserted into the termination of the thoracic duct, is sometimes also inserted into the trunk of the right side; in which, as I have already said, I have seen the chyle. The same arguments may be employed against the objection of the obstructed thoracic duct; and in whatever point of view we consider this subject, there is not one solid argument in favour of absorption by red veins.

CHAP. VI.

A more particular History of the Lacteals and Lymphatics.

EUSTACHIUS, a Roman anatomist, was properly the first discoverer in this part of anatomy. It appears, that about the year 1563, he saw the thoracic duct, or what is now known to be the trunk of the absorbent system, in a horse. He has particularly described it in his Treatise de Vena sine Pari, where he calls it Vena Alba Thoracis. Of the left subclavian vein, he says, "Ab hoc ipso insigni trunco sinistro jugali qua posterior sedes radicis venæ internæ jugularis spectat *magna quædam propago germinat*, quæ preterquam quod in ejus origine ostiolum semicirculare habet, est etiam alba et aquæi humoris plena; nec longe ab ortu in duas partes scinditus, paulo post rursus coeuntes in unam, quæ nullos ramos diffundens, juxtà sinistrum vertebrarum latus, penetrato septo transverso, deorsum ad medium usque lumborum fertur; quo loco latior effecta, magnamque arteriam circumplexa, obscurissimum finem mihi adhuc non bene perceptum obtinet."

From this quotation, it is impossible to doubt his having seen the thoracic duct; but, not understanding it, he begins at its termination in the left subclavian vein, and traces it downwards to its origin, where it is no wonder he was bewildered, since the art of injection was not then found out; and, as we shall afterwards see, hardly any of the succeeding anatomists have had clear ideas on that subject.

The anatomists seem to have paid very little attention to this discovery of Eustachius. He is said, by some, to have ascribed to this vein the function of nourishing the thorax; but he himself expressly disavows any such idea, and says, "*quamvis minime sit ad thoracem alendam.*" It is not to be wondered, that they made but little enquiry about what he himself confesses he did not understand.

No more, therefore, of this system was heard of till the year 1622, when Asellius, an Italian anatomist, investigating the motion of the diaphragm in a living dog, in the presence of some medical friends, accidentally discovered white fibres on the mesentery. He took them at first for nerves; but observing, that after puncture they discharged a white fluid, and quickly became collapsed and invisible, he pronounced them to be new vessels. Repeated experiments confirmed him in this idea. He went farther; he was not only the first who saw these vessels, knowing them to be different from arteries and veins, but he also, with much sagacity and penetration, announced their peculiar office. He observed, that they were often invisible on the mesentery, whilst the arteries and veins were at all times perfectly evident: that whenever the intestines contained chyle, these vessels were always full of a similar white fluid. For these reasons he called them Vasa Lactea, and assigned them the office of absorbing chyle from the intestinal tube, and carrying it into the blood. Before his time, the vessels of the human body, and of quadrupeds, were said to be of three kinds, arteries, veins, and nerves. Having discovered the lacteals, he naturally terms them the fourth kind.

"Vasa meseraica Galenus et omnes post eum anatomici pariter et medici genere triplicia faciunt venas, arterias, et nervos."

"Aliud est genus quartum novum ac ignotum hactenus, et a me primo observatum."

These vessels he discovered not only in dogs, but in a variety of other quadrupeds. He tells us, "Confirmatus gemino hoc experimento, et nihil amplius de re ipsa ambigens, totum me dedi ad perquirendam eam percipiendamque accuratius, in quam curam ita incubui nulla ut temere hepdomada, certe nullus mensis abierit sine viva una aut altera sectione. Nec vero in canibus tantum, in brutis plurimis aliis factum periculum, in felibus, in agnis qua lactentibus adhuc qua herbam jam pascentibus. In vaccis præterea et porcis aliisque veritas exquisita. Quin equus etiam huic uni rei emptus et vivus exenteratus."

It does not appear, that Asellius had ever seen the human lacteals: the dissection of dead human bodies was not at that time practised. Haller says, in his Bibliotheca Anatomica, that about the year 1600, the Republic of Padua, before that period famous for anatomists, omitted even the public dissections, from parsimony. The Germans were then engaged in war; and the English had hardly begun to dissect human bodies. Hence, says he, arose a fondness for comparative anatomy; "ut per quadraginta annos in anatome comparata usque vivorum etiam potissimum animalium medicorum scalpelli occupati fuerint." In this situation of anatomy, Asellius, of course, could have no opportunity of seeing the human lacteals. His enthusiasm would have led him to have opened living men, as he had living dogs; but he gravely informs us, that he checked that inclination: "Hominem vivum quod tamen Erasistratus olim et Herophilus non timuere, non incidi fateor; nec incidam, qui nefas et piandum morte cum Celso existimo præsidem salutis humanæ artem pestem alicui eamque atrocissimam inferre."

Though Asellius had not seen the lacteals in men, he inferred their existence from analogy, and firmly asserted it. But this doctrine was far from being generally received; and the doctrine of Hippocrates and Galen, which taught that the chyle was absorbed from the intestines by the red veins, more generally prevailed; and Asellius's vessels were considered by the greater number of anatomists as fictitious. Nor was this to be wondered at: they were not only influenced from respect to the ancients, but Harvey, the great discoverer of the circulation of the blood, then in his career of glory, opposed the doctrine, and never believed the existence of Asellius's lacteals.

"Apertum itaque est, chylum, quo cuncta animalia nutriuntur, ex intestinis per venas meseraicas deferri, nec opus esse ut novum iter venas lacteas scilicet inquiramus, aliumve transitum in adultis comminiscamur, præter eum quem in ovo et pullo compertum habemus."

In another place he says, " In plurimis animalibus chyliferi hi canales non omnino reperiuntur."

" Neque in ullis omni tempore occurrunt, cum tamen vasa nutritioni destinata debeant necessaria omnibus animantibus, omnique tempore adesse."

For several years little was added to Asellius's discovery: but in 1634, Veslingius, according to Haller, first saw the lacteals in men, and gave a figure of them. This figure is not very correct; but neither are the figures of the skeleton itself, given by the earlier anatomists, more correct: nor have we a right to expect, that a person who sees any thing for the first time, can conceive it, or draw it, as well as more opportunities would have enabled him to do, or as one who comes after him, with the advantage of his knowledge, may be able to do. It appears also, from passages alluded to by Haller in Veslingius's posthumous works, that he was the first who saw the lymphatics of the liver, though he took them for lacteals. As Bartholin, to whose care these works were intrusted, must have read these passages, Haller thinks it extremely probable, that it was there he received his first information of the lymphatics. " Cum præterea ad Bartholinum posthuma scripta clari viri pervenerint, et hi ipsi loci a Bartholino editi sunt, summe probabile fit hunc scriptorem vestigia Veslingii secutum, ostensam sagaci viro prædam majori felicitate adtigisse."

As a farther proof of his abilities, Haller mentions him as the first discoverer of the thoracic duct, after Eustachius. " Idem Veslingius, nisi plurimum fallor, primus post Eustachium, contra omnes coætaneos, rectius, anno 1649, vidit vas lacteum grande in pectus adsendere; cum reliqui incisores, partim ab Asellio persuasi, et partim a lymphaticis vasis hepatis seducti, chyliferos ductus ad hepar ducerent."

In a still later work, his Bibliotheca Anatomica, Haller, speaking of Veslingius's posthumous work, terms it " aureum undique opusculum cujus non licet hic divitias omnes decerpere;" and then adds, " de lacteis vasis etiam in homine visis plurima experimenta habet, et anno 1647 duplicem ductum chyliferum vidit."

Whatever Veslingius might have known, it has been latterly understood that Rudbeck, a Swede, twenty-eight years after Asellius's discovery of the lacteals, without any previous information on this subject, also discovered the lymphatics in quadrupeds. He supposed them a fifth set of vessels; and as they neither carried red blood, like arteries and veins, nor chyle, like the lacteals, but a transparent fluid, like serum, he calls them Vasa Serosa.

About the same time, Bartholin, the Dane, also saw these vessels; but, independant of the hints he received from Veslingius, there are suspicions that he must have previously heard of Rudbeck's discovery; for, in his publication on this subject, he says, "Sibi vasorum serosorum nomen non placere quod aliqui his vasis imposuerint."—Bartholin changed the name into Vasa Lymphatica, a name they have still retained; for, as he first published an account of them, and as he was a man of more eminence than Rudbeck, the whole medical world gave him the credit of the discovery. He himself, however, seems to be content to share this discovery with Rudbeck and Jolyffe: "Similes aquosos, ductus detexit et postea descripsit Olaus Rudbeck: in Anglia de Jolivio quoque suo gloriantur amici; quin nobis, cum aliis hinc inde visa sunt negare nolim; sed nobis qui primi in arenam descendimus nullus mortalium viam demonstravit."

Bartholin having mentioned Dr. Jolyffe, it may be proper also to state the grounds of his claim to the discovery of the lymphatics. Glisson says, that in the beginning of June, 1653, Dr. Jolyffe, who was then taking his degree at Cambridge, informed him, "Dari vasorum quartum genus a venis, arteriis, nervisque plane diversum, idemque ad omnes aut plurimas saltem corporis partes distribui, et humorum aquosum in se complecti. Addebat porro se in compluribus animalibus eorumdem ductum investigasse in artubus, scil. testiculis, utero, aliisque etiam partibus: certoque sibi constare liquorem in iis intro versus mesenterium tendere, et particulatim ad initium sive radicationem ejus."

As to Glisson's evidence, I must observe, that Dr. Jolyffe considered the nerves as vessels, and therefore uses the words "quartum genus vasorum." At the same time, he appears to me to have forgot Asellius's discovery of the lacteals, or he would have said "quintum genus," unless he imagined his vessels and Asellius's the same; and then Glisson would never have seriously informed us, that Jolyffe had discovered a new set of vessels, Asellius having informed us of them long before. Three years also intervened between this discovery of Jolyffe's and that of Rudbeck's.

Charleton also says, "Norunt autem e doctissimis nostri Med. Lond. Collegii tum sociis tum candidatis complures novum isthoc vasorum genus per annos, aliquot antequam Bartholinus de eo quicquam scripto publico divulgarat a Jolivio nostrate, quo accuratius feliciusve nemo usus est unquam cultello anatomico, et cui si fata longiorem vitam indulsissent——— sæpius et observatum fuisse."

And Boyle attests the same thing:—"By an accident too, as himself hath told me, did our industrious anatomist, Dr. Jolyffe, first light upon these yet freshly detected vessels; which afterwards the ingenious Bartholinus, without being informed of them, or seeking for them, hath met with, and acquainted the world with under the name of Vasa Lymphatica."

Though, in compliance with anatomists in general, I have considered the Absorbent System as consisting of two parts, and have given the history of the discovery of each part; yet, in fact, the lacteals and lymphatics are branches of one common trunk in the same animal. In birds, the chyle and lymph are similar in their appearance to the naked eye, and when viewed in the microscope, it is impossible, from their appearance, to distinguish the one from the other; neither has any chemical experiment, hitherto made, shewn how to distinguish the one from the other. In animals, where they are perfectly distinguished in their appearance, the same vessels, as in the diaphragm, sometimes carry the one, sometimes the other, as I have often seen, and as is confirmed by several eminent anatomists; even the thoracic duct itself has been seen tinged with lymph: "puriorem," says Noble, "fuisse receptaculi humorem, quam lympha pericardii;" Haller says, "cum lac esset in vasis lacteis vidi in ductu thoracico, lympham fuisse:" and again, "Porro vulgare omnino experimentum est, neque expectatum, vasa quæ pulcherrima lacte, plena ex intestinis prodibant sub oculis intentis incisoris diaphano humore et lympha etiam rubella repleri, vel dum vivit animal, vel omnino etiam a morte sepe in variis vidi animalibus. Eodem etiam tempore in eodem animale eodemque mesenterio vasa lactea in aliis intestinis alba, diaphana in aliis non raro videas:" and therefore Veslingius, Rudbeck, Bartholin, and Jolyffe, may be rather said to have seen the vessels first seen by Asellius, in other parts of the body as well as in the intestines, mesentery, and liver. They did not properly discover a new set of vessels, but some more branches of the same system. On the other hand, Asellius had an idea that his vessels were formed only for the purpose of carrying the chyle into the blood; he had no conception of their existing any where else; so that, without the discovery of the lymphatics, we must have remained ignorant of the greatest part of the absorbent system; and therefore they are equally entitled to the honour bestowed on discoverers of so important a part of our machine.

The three first of these anatomists not only found Asellius's vessels in a great many other parts, but they corrected his error in making the lacteals go to the liver; and they found out the trunk of the system. They also demonstrated all this in the human subject. It does not appear, however, that they understood the lymphatics to be exactly the same vessels as the lacteals. Rudbeck thought that they absorbed, as Asellius had asserted and proved of the lacteals; at least he comes very near the doctrine; but proposes it rather as something he suspected, than a thing he was certain of. "Ita hæc quoque vasa, ad aliqua munera obeunda extructa fuisse arbitor—intus excavata et fistulosa sunt, infinitas habentia valvulas, ne humor e glandulis vel aliis partibus *exsuctus* iterum refluat."

Bartholin, whose doctrine was better known, and more commonly received, though he was perfectly satisfied as to the origin and functions of the lacteals, had doubts respecting the origin and functions of the lymphatics; for he says, "Exortus lymphaticorum vasorum est ab externis partibus, seu, artubus, et visceribus, hepate nempe vesicula fellis, &c."

"Qua parte ex artubus prodeant, an a venarum extremis, vel musculis, nec dum oculis assequi potuit ob vasorum subtilitatem. Conjecturæ si quis locus, a partibus nutritis debent emergere ob usum postea asserendum, quanquam nec a venis capillaribus impossibilis sit exortus."

"Qui in nervis circulationem admittunt nullam commodiorem hæc viam invenient."

The absorbents have since been found in other classes of animals; but had they never been found in any other, it could not have, with any propriety, affected our reasonings on men and quadrupeds, where we knew they actually existed, and where their function appears to be as certain as their existence. All that we have gained by the discovery of these vessels, in amphibious animals, birds, and fishes, is the proof of the simplicity and uniformity of nature, in doing the same thing, in all the different classes of animals, in the same way.

Mr. Hunter first discovered them in crocodiles, and in geese.

Mr. Hewson first discovered them in turtle, and believed he first saw them also in fish.

Thomas Bartholin, however, claims a prior right to the last, if we are to give him credit, having seen those vessels in the globe fish : " Fide mea apud te, mi Horsti, exciderim nisi in omnibus animalibus reperiantur maximis minimisque ; in ipsis quoque piscibus, quod ORBIS exemplo quidem demonstravi."

Haller also mentions this ; and, speaking of Bartholin, says, " Ex *orbe* pisce lactea ad hepar euntia descripsit."

Haller, at one time, entertained doubts of the existence of these vessels in other parts of the body than where they had been seen ; and thought them, to the last, too inconsiderable to perform alone so important an office as absorption.

" Respondebimus interim," says he, " resorbtionem peragi ubi nunquam certa fide ejusmodi vasa ostensa sunt ut in cerebro, pleura, peritonæo et cute."

Again :—" Sed neque oculorum lymphatica vasa in nuperis experimentis aut meis aut Zinnii clarissimi adposuerunt—medullæ spinalis aquosa vasa nondum satis iteratis periculis confirmata habemus."

" In capite, et artubus pauca."

" In vola manus, dorso pedis, dorso trunci, natibus nulla omnino descripta."

And, lastly,—" Deinde fateri oportet, post tot industriorum virorum labores fragmenta tamen esse, ea omnia quæ de vasis lymphaticis scimus, neque ullo modo cum arteriorum et venarum, aut nervorum historia descriptiones vasorem aquosorum comparari posse."

Later writers than Haller have also treated the lymphatics and lacteals, or real absorbents, as a trifling appendage of the red veins.

CHAP. VII.

Lacteals seen by the Ancients, but not understood.

I MUST observe, however, that there are some vestiges amongst the ancients, that prove they had also seen lacteals. In the first place, there are passages in Hippocrates, or in the books ascribed to him, from whence it is suspected that he knew something of the lacteals; for, after he has described the larger veins in the body; he says, " Εισὶ δὲ καὶ ἀπὸ της κοιλης φλεβὲς ἀνὰ τὸ σῶμα πὰμπολλαί τε καὶ παντοῖαι, δί ὧν ἥ τροφὴ εν τῶ σωματι ερχεται."

" There are also in the body, veins from the stomach, very many, and of all kinds, by whose means the food comes into the body."

Here I must observe, that Hippocrates, or whoever he was who wrote this sentence, could not mean the real absorbents: no vessels different from arteries and veins are easily to be seen there. The lymphatics of the stomach are found with very great difficulty, as they never, like the lacteals, carry an opaque fluid.

Galen contending, that the arteries contain something else than air, says, that it was the doctrine of Erasistratus, that they contained both air and blood, but that they first emptied themselves of the air before they took in the blood. Tending to the same purpose, he mentions the following experiment, as from the works of Erasistratus: " Εν γαρ τῶ διαιρεῖσθαι το ἐπιγὰστριον, ἅμα τῶ περιτοναίω, κατα τὸ μεσεντέριον αρτηρίας ιδεὶν ἐστι, σαφῶς, ἐπὶ μεν των νεωθηλων ἐρίφων γαλακτος πληρεις."

" For on dividing the epigastrium, and along with it the peritonæum, we may clearly see arteries, on the mesentery of sucking kids, full of milk."

Asellius seemed to be perfectly aware of this; for he says, in his book on the Lacteals, " Denique nec minus verum illud est, quod addidi, visa quibusdam eorum fuisse, nec tamen cognita. Erasistratum enim, et ejus asseclas intelligo, quem vidisse nostras venas, et suis ostendisse, ex duobus Galeni locis manifestum mihi est. Ex utroque enim liquet ad probandum solum spiritum in arteriis attineri, confluere autem post sanguinem, vel aliam naturam quamcunque, experimento hoc anatomico usum esse, quod in hædis nuper lactatis, si venter imus et interior membrana dividantur, initio simul scilicet, ac nudatum mesenterium fuerit, arteriæ ἀιεροειδεῖς, id est, aere, mox plenæ lacte conspiciantur. Vidit igitur omnino lactea hæc vasa, nec agnovit tamen, quippe, quæ pro arteriis, deceptus veri quadam inani similitudine, habuerit. Ex quibus omnibus satis, opinor, patet, ignorata fuisse hactenus vasa, quæ primi invenisse profitemur."

Galen also says, that Herophilus taught, there were veins arising out of the intestines, which did not go to the liver, but to certain glands on the mesentery, and which were the nutrient veins of these glands. "Πρῶτον μεν γάρ παντι τω μεσεντερίω φλὲβας εποιησεν ἰδίας ανακειμενας ἀυτῶ τη θρεψει των ἐντέρων μη περαιουμὲνας εἰς το ἧπαρ. ὡς γαρ καὶ Ηροφιλος ἔλεγειν, εις ἀδενῶδη τινὰ σῶμάτα τελευτῶσιν ἇυτας ἁι φλὲβες, των ἄλλων ἁπασῶν επι τας πυλας ἀναφερομὲνων."

"For, in the first place Nature has made, in the whole of the mesentery, peculiar veins, destined for the nourishment of the intestines, not passing to the liver: for, as Herophilus says, these veins terminate in certain glandular bodies, whilst all the rest are carried upwards to the portæ (or liver)."

From the passages I have quoted, it is evident that the ancients understood something of the doctrine of absorption: it is also, I think, not to be denied, that they had seen parts of the real absorbent system, though they did not understand them.

CHAP. VIII.

Further Confirmation of the Absorption of Fluids by the Lymphatic Vessels.

THAT the lacteals absorb from the intestines, has been so fully proved, that there is not now an anatomist living, who has the smallest doubt concerning the fact. They have not only been seen absorbing the chyle, but they take up, very readily, coloured fluids thrown into the intestines. Every experiment Mr. Hunter made on the intestines of living animals, at the same time that it refuted the doctrine of absorption by red veins, in the strongest manner confirmed that of absorption by the lacteals. They quickly absorbed the milk, the solution of starch in water, coloured with indigo, the musk-water; in short, every fluid which was thrown into the cavity of the intestines. I have already mentioned the arguments which induced Dr. Hunter to advance the doctrine, that lacteals and lymphatics were the same species of vessels, and that both absorbed. I come now to offer some additional proofs of this. An accustomed eye finds very little difficulty in distinguishing lymphatics from every other species of vessel, in men or quadrupeds; their valves, their general appearance, their intercourse with conglobate glands, sufficiently mark them. Now the lymphatics are not only branches of the same trunk, as Dr. Hunter observed, but there is such a connection between them, such an anastomosis, that the fluids absorbed by the lacteals are in part transmitted to the lymphatics, and through them, at last, conveyed into the blood. A very remarkable instance of this kind I demonstrated at lecture in Windmill Street, in the year 1785. The lymphatics of the diaphragm, which also belong to the liver, were seen turgid with chyle, which they had received from the lacteals, some of which were passing that way, towards the subclavian veins. A stronger proof that lymphatics are absorbents, is, that whenever fluids are extravasated on surfaces, or into cavities, or whenever such fluids preternaturally distend their reservoirs, the lymphatics belonging to these surfaces and cavities are found full of the same fluid. This is better demonstrated, when the fluids mentioned happen to be of a strong colour. Thus I have repeatedly seen, in animals dying of hæmoptoe, and in the human subject itself, the lymphatics of the lungs, which at other times contain a transparent fluid, turgid with blood, which they had absorbed from the air-cells. Where gall-stones, in the ductus communis coledochus, or in the cystic duct, have prevented the bile from flowing into the intestines, and the gall-bladder, in consequence of this, became preternaturally distended with that fluid, I have also seen the lymphatics of that reservoir full of the bile they had absorbed from its cavity. Baron Haller asserts, that he had repeatedly seen the lymphatics, as well as the lacteals, full of the coloured fluid he had thrown into the living body. " In animale, cui plena fuerunt aut chylo, aut lympha, aut cæruleo liquore, quem animalia, absorbere coegi, sub ipsis intentis meis oculis, toties vidi hæc, sive lymphatica vascula, sive lactea evanescere." Malpighi suspected that the lymphatics persisted in absorbing, even for some time after death; I found this to be true in quadrupeds: on making ligatures on the trunks of the principal blood vessels, no lymphatics were then visible; but in an hour after I found them turgid with lymph.

Some modern anatomists assert from experiments, that the absorbents of the human body, even 40 hours after death, take up warm water coloured with ink, and thence become visible.—These experiments did not succeed with me.

In women, on the third day after delivery, when the breasts become tinged with milk, the lymphatics commonly relieve the distension by absorbing part of the milk, and carrying it back again into the blood; these lymphatics pass through the glands of the arm pits, and either from the new stimulus, or from distending them more than usually, the milk inflames them, they swell, and become tender to the touch.

When a child has been innoculated in the arms for the small pox, the variolous matter begins to be absorbed from the artificial pustle on the 7th day, sometimes red lines may be seen going from it to the lymphatic glands of the arm pits, sometimes only hard and tender cords, as it were, may be felt; but whether these be present or not, the glands very commonly swell and become tender to the touch, exactly in the same way as when the venereal matter of a chancre passes from the penis to the glands of the groin in producing a bubo.

These last proofs are not so strong as those examples where we see the matter absorbed actually in the absorbing vessels, but we have the strongest reason from analogy to believe, that the symptoms stated, are equally the effects of absorption by the lymphatics.

CHAP. IX.

Methods of discovering the Lymphatics and Lacteals.

THE arteries and veins are easily found, and pretty generally known. Their trunks arise from, or terminate in, the heart; and, as this may easily be found in most animals, hence it is not difficult to find the arteries and veins: but the trunk of the absorbents not terminating immediately in the heart, but in the veins, at some distance from it, and this trunk, when it is found, being crowded with valves, which makes the injecting from the trunk to the branches, as in the arterial system, impossible, the absorbents are with difficulty detected, and in proportion less known. It is for this reason I have chosen to give the different methods of finding them.

The lacteals were discovered in consequence of the animal's being opened alive, some hours after it had been fed: these vessels were then seen turgid with the chyle they had absorbed from the intestines. At all other times, they are either empty, or contain a small proportion of colourless or transparent fluid. Anatomists still continue to employ this method with success. From the experiments formerly mentioned, as made on living animals, it appears, that these vessels may be made visible at any time, by throwing coloured thin fluids into the intestines, as these are almost immediately absorbed, and appear in the lacteals. Ligatures made on the trunk of the superior mesenteric artery must necessarily include the trunk of the absorbents: such ligatures, therefore, in the living animal, preventing the absorbed chyle from passing into the thoracic duct, and of course detaining it in the lacteals, are very useful in demonstrating these vessels. An eye accustomed, readily distinguishes lacteals on the intestines from arteries and veins, even when they are collapsed and empty: punctures may be made with a lancet, and the vessels injected with quicksilver by means of a tube formed expressly for that purpose. I have sometimes injected the lacteals, from punctures made by the sides of the veins, where I knew they must be, though they were then invisible to the naked eye.

When the glands of the mesentery have been enlarged from scrophula, I have observed that the lacteals were then larger, and easier to be discovered or injected: this I consider as the consequence of obstruction in the glands, and of encreased action in the vessels, in order to overcome that obstruction; though I do not remember an instance of such obstruction in the mesenteric glands, as made the chyle remain in the vessels.

The lymphatics, in general, are not so easily discovered. On the liver and lungs they are frequently visible, though collapsed and empty; and may be injected by puncturing one of the small branches, and throwing in mercury in the course of the absorbed fluids; but the valves almost always make the injecting from the trunk to the branches impracticable. Though the trunks of the lymphatics are generally collapsed and empty in the dead body, yet the extreme branches almost always contain some little reddish or brownish fluid, which, by pressure in the direction of the course of the absorbed fluids, may be forced from these extreme branches into the trunks, and, by this means having become visible, may be punctured, and injected with quicksilver. I have, in this way, succeeded in injecting the lymphatics of the kidney.

Watery fluids thrown into the arteries, veins, or excretory ducts of the glaudular viscera, very commonly get into the lymphatic vessels, which then becoming visible, punctures may be made in the small branches, and the watery fluids be forced out or displaced by injecting quicksilver.

One of the best methods I have found was, previously injecting the arteries and veins of the part where I wished to see the lymphatics, and then throwing it into water, to macerate, for some days; as soon as a certain degree of putrefaction takes place, air is let loose in the cellular membrane, from whence it gets into the orifices of the lymphatics, and uniformly fills their branches: in this way I first discovered them on the heart and in the uterus; punctures may be then made in the smaller branches, and the air may be forced out by an injection of quicksilver.

I must here observe, however, that in employing this method it will sometimes be necessary to inject, previous to the maceration, several sets of veins, and perhaps some other species of vessel also, before it can be fairly inferred that any new vessel filling itself with air is a lymphatic.

Were one to set about discovering the lymphatics of the liver in this way, he must inject previously the hepatic artery, then the vena portarum, then the venæ cavæ hepaticæ, and other smaller veins entering the cava, but not properly branches of the former: when he has done this, he must also inject the ductus hepaticus, and its branches the pori biliarii, before he could infer that any new vessel filling itself with air, in consequence of maceration of the viscus in water, was a lymphatic. I must, however, observe, that on the extremities this method cannot be employed, as the valves prevent us from injecting the veins, unless on some lucky occasion, where they are now and then injected from the arteries, as continued but reflected tubes, and in the course of the circulating blood.

The lymphatics are with more difficulty discovered on the fore-arm and leg than in most other parts. Here the choice of the subject is a very material circumstance: there should be no fat in the limb; it should be dropsical, and yet not too much so. The fat hides the lymphatic vessels so as to prevent our seeing them. If there is much water in the cellular membrane, the vessels are very well seen; but they are not sufficiently supported: they roll under the point of the lancet, and escape the attempts to puncture them; or, if the puncture has been effected, they glide away from the point of the injecting tube. I have seen some hundred vessels on an extremity, where, for the reasons I have just given, I have been only able to inject a few. When a proper limb has been procured, I make ligatures on the top of the foot, or back of the hand, and, by repeated stroking of the toes or fingers, force the brown fluid in the extreme branches of the lymphatics into larger branches: the ligatures prevent it from being drove on, and the vessels gradually become distended close by the ligature. The integuments are then to be removed, so as to leave the absorbents, which lie immediately underneath, intire. Punctures may then be made in the vessels, and quicksilver may be injected. From a single puncture in a vessel on the top of the foot, I have injected sixteen absorbents running the whole length of the thigh. It has been said, that in cases of induration of the lymphatic glands in the axilla or groin, some have found the lymphatics of the arm and leg distended with their own lymph, which not being able to get through the diseased glands, stagnated in the vessels, and made them so distinctly visible, that they drew them as if they had been injected with mercury.

Instances of this kind have never occurred to me, and I should not easily trust to any drawings made in this way; even on the mesentery of children, where indurations of the glands are so frequently met with, I have never seen the lacteals on the intestines visible from this cause.—There is a disease of the lacteals in which they are sometimes seen filled, as it were, with cheesy matter, but this, like the similar affection of their glands, is not from coagulated or inspissated and indurated chyle, but certainly from scrophulous pus, which is very often solid and white in glands at a great distance from the rout of the chyle.

In the upper part of the arms and legs, the business of injecting and discovering the lymphatics is easier. A gland is almost always to be found on the fore-part of the internal condyle of the humerus. This gland may be punctured with a lancet, and the tube, filled with quicksilver, may be introduced by this opening; or, which succeeds equally well, the tube may be pushed into the substance of the gland at once, without any previous puncture by the lancet. The mercury thus fills the cells of the gland, and from these the deeper seated absorbents, which run with the brachial artery. In the lower extremity, the absorbents, which run with the femoral artery may be injected in the same manner, from glands situated in the ham. The trunks of the lymphatics, from the heart and lungs, may be injected in this way, from glands about the root of the lungs and fore-part of the trachea. The absorbents of the neck, in this way also are injected, from glands very constantly found on or behind each mamillary process. The trunk of the system itself, the thoracic duct, is most successfully injected in the same way, that is, either from some gland on the mesentery, on the bodies of the lumbar vertebræ, or on the inside of Paupart's ligament.

When vessels are injected, and very much resemble lymphatics, the best method of determining whether they are or are not lymphatics, is to trace them to the nearest lymphatic glands: if they terminate in them, in the usual manner, they are lymphatics.

The course of the absorbents may sometimes be determined by attending to the progress of cutaneous inflammations; when an erysipelas, for example,

ample, arises in the back, between the scapulæ, soon after the glands behind, the mamillary processes of the temporal bones, swell and become tender, shewing, that the absorbents of this part of the skin, run upwards, to some distance from their origin, and that they pass through these glands.

In pulmonary consumption I have frequently applied a plaister made of powdered gum ammoniac dissolved in vinegar of squills, to the skin, over the sternum. This plaister ulcerates the skin, and every now and then in- the absorbents and their glands: in this way I learned that the absorbents of this part of the skin went partly into the axillæ, partly under the clavicles, and partly with the jugular veins, for the glands in all these places swelled, and became tender.

The same plaister applied to the integuments of the abdomen, or those of the hypochondriac regions have also occasioned swellings and tenderness in the glands of the groin, pointing out the course of the lymphatics, long before I actually saw them running this way; I have seen the glands of the groin also become swelled and tender from inflamed piles, round the verge of the anus and thence inferred that some of the absorbents of these parts came round the inside of the thighs to the groins. I have not, however, described any of these, excepting such as I have actually injected.

CHAP. X.

Origin of the Lacteals and Lymphatics.

FROM the several facts already mentioned, it is evident that the lacteals, taking up whatever is thrown into the cavity of the intestines, must arise from their internal surface; that the lymphatics of the lungs, absorbing blood from the air-cells, must have their origin from these cells; as well as that those absorbing bile from the gall-bladder, must have orifices opening into that cavity.

That mercury is absorbed from the skin, cannot be doubted; for, when rubbed on the skin, it produces a brassy taste in the mouth, stimulates the salivary glands, the intestines, and sometimes all the glands of the body, and produces all other appearances which it does when taken into the stomach. The same is true of many other medicines. It is therefore evident, that the lymphatics arise from the skin. Also, it may be inferred, as they arise from these cavities and surfaces, that they probably arise from all cavities and surfaces of the body. In confirmation of this, we find fluids morbidly accumulated, absorbed from all the cavities of the body.

We know that this accumulation is, in the healthy state of the body, constantly prevented by the same vessels. This idea appears long ago to have presented itself to the ingenious Willis: " Enimvero sæpe sæpius miratus sum quid fiat de effluviis vaporosis, quæ perpetim, è sanguine in præcordiis efflagrante, copiosissime, et nonnunquam impetuosissime dimanant." And then, by and by, speaking of the lungs, he explains this, and says, " Quapropter loculi, seu spatia ista inania ubique ex omni parte disponuntur, quæ vapores in pulmone occlusos excipiant, et eosdem mox condensatos per lymphæ ductus, quasi per totidem alembici rostra, extillent."

This doctrine is also proved by injecting fluids into the abdomen in living dogs, which are quickly absorbed; of six pints of warm water, after six hours, not more than four ounces remained. The water of the hydrocephalus, deposited in the ventricles of the brain, we have every reason to believe, has been sometimes absorbed from these cavities; for the symptoms of the hydrocephalus, which are exceedingly well marked, have made their appearance, and then, from the use of remedies, again disappeared. The water of the hydrothorax has also sometimes been removed; and we have occasionally known ascites cure itself. Now, as it has been proved that transudation does not take place in the living body, it follows, that if fluids are deposited in, and then removed from, cavities, it must be by absorption, the only power we know an animal body to be possessed of, which is adequate to this effect. In œdema of the legs, friction, we know, frequently occasions a removal of the fluid. Now, as friction becomes a stimulus to the arteries and veins, and accelerates the motion of the blood through the parts, we have reason to conclude, that the same friction becomes a stimulus to the lymphatic vessels, and obliges them to take up the extravasated fluid. When the bones are diseased, the lymphatic glands in their vicinity become inflamed, and suppurate as in the diseases of soft parts. This circumstance proves that the lymphatics arise also from the bones. To this it may be objected, that the bones are never diseased, without the soft parts participating more or less in the disease, and it may be the lymphatics of the soft parts, and not of the bones, which are thence affected: but, as I have injected the lymphatics of bones, and know them to be possessed of these vessels, as well as the soft parts, this objection carries but little weight with it; and the conclusion I have drawn, is a much more natural one. Malphigi had an idea, that the lymphatics arose only from follicles; but these vessels are found in many parts of the body where there is not the least vestige of a follicle. They were next said to arise from the excretory ducts of glands, and they certainly do so, but not more particularly from these than from other parts. I have repeatedly injected quicksilver (a fluid which I never found transude) into the tubuli lactiferi in the breasts of women and of quadrupeds, and generally found that I injected the lymphatics at the same time; the mercury passing into the orifices of the lymphatics, arising from the internal surfaces of these ducts.—Mercury likewise, thrown into the ureters, has frequently returned by the lymphatic vessels, which were arising from their internal surfaces. The same injection, thrown into the ductus hepaticus, has returned by the lymphatics of the liver: Haller says, "In hepate, aer aut argentum vivum per ductum coledochum impulsum, in lymphatica vascula venit, ut etiam facilius per eum ductum, quam per portarum venam, ea pellucida vascula replentur." The lymphatics are among the vasa vasorum of arteries and veins, and certainly arise from their external surfaces. I am also fully persuaded that they arise from their internal cavities. In animals strangled, or dying of some violent death, the lymphatics about the spleen, and in the cavity of the abdomen in general, are almost always found turgid with blood, though I have never seen, on these occasions, any marks of extravasation of that fluid into the cellular membrane. In peritoneal inflammation, I have demonstrated the lacteals full of blood, though in this inflammation there is little or no swelling, of course no extravasation of blood into the cellular membrane. I have seen the absorbents of the lungs also loaded with blood, in the peripneumony or inflammation of their substance; and on all these occasions have been induced to believe that the lymphatics arose from the internal surface of arteries and veins. This doctrine is not without its difficulties; for arteries and veins have been distended with injected fluids on many occasions, without the smallest drop of these fluids passing into the lymphatics; and one of the arguments, by which the origin of the lymphatics from surfaces is supported, is, that they cannot be injected from arteries or veins. On the other hand, there is no anatomist, who has been at all conversant in injecting arteries and veins, but on some occasion or another must have found, that from these he had also injected the lymphatics. " Certe novimus," says Haller, " nulla arteria fracta, nullo liquore extra vasa effuso, tamen per arterias, vasa lymphatica, ipsumque ductum thoracicum repletum fuisse." I have injected the thoracic duct, and many of its branches, from the umbilical vein, in children. I do not pretend to say whether this was from the arteries or veins, for, in this way of injecting, the ductus venosus foramen ovale and ductus arteriosus being all open, both arteries and veins are injected at the same time. On the process of the peritonæum of the porpoise, through which the spermatic vessels run, I inflated the absorbents from the veins with the gentlest breath I could blow: But here it may be objected, that in this animal there may be some uncommon connection between red veins and absorbent vessels. I cannot say, that there may not be such connection: but I strongly suspect that there is not. Professor Mekel says, " Bis, hac etiam præterita hyeme, vasa lymphatica, et ipsum ductum thoracicum, ex venis replevi."

If lymphatics, it may be said, arise from arteries and veins, why do we not oftener inject them from these vessels in the dead body? To this I reply, the veins are certainly continued from the arteries, and yet we count it a lucky injection, if we fill the veins from the arteries, unless the fluid injected is a very subtile one, and such as does not quickly coagulate; we can frequently, by injecting oil of turpentine into the arteries, fill the veins, but we cannot tell whether this happens from the oil of turpentine passing through the capillaries, or by transudation, as this fluid is very apt to transude. Quicksilver often returns by the veins, and, as it never transudes, we are more certain of the manner in which it passes; but the quicksilver will not always return by the veins. I have injected the arteries of the intestines to the utmost with quicksilver, and yet not a particle has returned by the veins. I have reversed this, and injected the veins to the utmost, and yet none of the quicksilver returned by the arteries. Are we, therefore, to infer, that the arteries and veins are not connected, after so many proofs that they certainly are? Again it may be said, if lymphatics are connected with arteries, like veins, why are they not, like them, full in the dead body? The veins then become full, and contain almost all the blood which the arteries and they together contained during life. The reason of this is evident: the blood in the arteries is not only propelled by the force of the heart; but the arteries continue to propel their contents, after the heart has ceased acting. As the veins are so much more capacious than the arteries, they easily contain the whole; and it must stagnate there, because, the lungs being collapsed, the blood of the pulmonary artery cannot get through, of course, it must remain full; and if it remain full, the right ventricle, for a similar reason, must do so too, and so must the right auricle, and thence the whole venous system. Now, if the lymphatics are connected with the arteries, why are they not also full in the dead body? In the first place, their connection with arteries is different from that of the veins. The veins must receive the blood propelled by the arteries, and are in some sense passive; but absorbents have their orifices sometimes immersed in fluids for years, and take up none of them till a particular stimulus for absorption is given. This we have sometimes seen in the natural cure of ascites, when the absorbents of the abdomen have of their own accord, and without the least assistance from medicine, in two or three days removed the whole of the contained fluid, though no alteration had taken place for years before. In the next place, the absorbents are still more irritable than the arteries. They continue to propel their fluids generally for some time after death; and, as the veins are fully capable of holding their fluids as well as those of the arteries, the lymphatics are empty in the dead body, and may notwithstanding be connected with the arteries and the veins too, in the way I contend. A proof, it has been said, might easily be adduced:—Fill the carotid, at that place where it is giving off no branches, with quicksilver, and let us see if any part of it, under the pressure of a large column, gets into the absorbents. If it gets in, we allow this doctrine; if it does not get in, it must fall to the ground! This does not follow. The ureters are inserted into the bladder, and bring the urine into it from the kidneys; yet neither water, nor air, nor any other injection, will pass from the bladder into the ureters in their natural state; this happens from the obliquity of the insertion of their orifices, which run for some way between the muscular and internal coats of the bladder, before they open into the cavity; and we do not know that there may not be a similar contrivance in the insertion of the mouths of lymphatics in the cavities of arteries and veins; which conjoined to their not acting but from a particular stimulus, may fully solve the phænomenon. The lymphatics, which arise from the interior surfaces of the arteries and veins, may have their orifices of such a nature as to be capable of taking fluids into them, or shutting themselves, and not receiving fluids, except in certain circumstances. It has already been shown, that it is very improbable that they are terminations of arteries, necessarily receiving fluids propelled by the force of the heart and arteries.

CHAP. XI.

Orifices of the Lacteals and Lymphatics.

THE ancients speak of the mouths of arteries and red veins, and of an absorption performed by these mouths, with great confidence. One would suppose, from reading the passages formerly quoted from Hippocrates and Galen, that they had certainly seen them: nothing, however, is more certain, than that the naked eye does not discover any distinct terminations of arteries, or beginnings of veins. These are lost in minuteness and number. The microscope only discovers some of these, in particular parts of living animals; it discovers the termination of arteries in veins, and of course, the beginnings of the veins: but the microscope itself has not enabled us to discover the orifices of the exhalent branches of arteries. As the ancients, then, had not the advantage of these instruments, they could not possibly see the termination of arteries in veins; indeed, they never once suspected any such termination, as it is now understood, much less could they see the orifices of the exhalent branches of arteries; and the veins, as has been already proved, have no inhalent orifices. Some of the moderns have, from anatomical injections of arteries and veins in the dead body, inferred the exhalent orifices of arteries and the inhalent orifices of veins. How little these injections are to be depended on, I have already shewn, and that the fluid injected, escaping into cavities and surfaces, from the arteries and veins, might be by transudation only. Others have asserted, that they have actually seen these orifices by means of the microscope, and have either seen the injected fluids run out from them on surfaces, or hanging in their mouths. Among these are Leiberkuhn and Mekel. The former inserted injecting tubes into the trunks of the arteries and veins of the intestines, filled these with fluids coloured differently, and, having exposed the villi belonging to these arteries and veins to the microscope, by gradually elevating the tubes from a horizontal to a perpendicular state, says he saw the fluids, by their own gravity, appear in the arteries and veins, and presently run out, at their exhaling and inhaling orifices, into the cavities of the ampullulæ or bulbous beginnings of the lacteals. His words are: "Nonnulli autem rami arteriarum et venularum supra descriptarum, trunculis his suis longe minores, perforant bululam lactei, et in hanc, apertis osculis, hiant." And again, speaking of the same vessels, he says: "Ramulus arteriolæ in cavum ampullulæ vasis lactei penetrans—Venosum ramulum in cavum ampullulæ lactei hiantem."—As it is certain, however, that he was deceived respecting the ampullula itself, so it is certain he must have been respecting these orifices. I have injected the villi of the human intestines with quicksilver to the greatest minuteness, but never saw a particle pass out from the extremities of the blood-vessels. Professor Mekel's absorption by red veins has already been disproved. If the orifices of the exhalent branches of the arteries have not been seen, it may be said, whence do anatomists infer that such orifices exist? I have already entered into this subject in my remarks on transudation, and shall only add, to what I have there said, that the phænomena of bloody sweat, and the menstrual flux, transferred to the skin, appear to prove, that there must be such orifices there, and of course every where else. Now it may be proved, that the discharge of blood referred to is, in the first place, from the arteries; and, in the next place, is not from rupture of those vessels. That the sweat is discharged by the arteries, is past doubt: they are the only vessels which carry fluids towards the skin. The red veins and lymphatics have their fluids passing in the opposite course, that is, towards the heart, or centre of the vascular system. If blood is discharged with the sweat, it must be from the same vessels which throw out that fluid. That the menstrual flux is a discharge from the arteries of the uterus, was an observation first made by Dr. Hunter. No where are arteries more easily distinguished from veins, than in this viscus: the arteries are there convoluted or curling; the branches of the veins are much larger, and are not convoluted. It happened that a woman died when her menses were flowing: Dr. Hunter examined the internal surface of the uterus, found it exceedingly red, and loaded with blood; that the principal redness was from the distended and convoluting arteries. He pressed forward the blood, which was fluid, and which, he asserted, never coagulated, and saw it appear on the surface near the extremities of these arteries. As this discharge happened instantly, and from the gentlest pressure of the finger, it could not be transudation, which always requires time; it could not be rupture of a vessel, or vessels. I have had several opportunites of repeating this experiment, which always succeeded in the same manner. Now, if this discharge is from the arteries in the uterus, there can be little doubt but that it is also from the arteries, when it is transferred to the skin.—That neither of the discharges is from ruptured vessels, is demonstrated from the regularity of the phænomena. In the transferred menses (which I have seen more than once, and have been informed by Dr. Hunter that he had seen several times, besides that it has been mentioned by Haller, Boerhaave, and others) the blood appears gradually, continues to flow regularly and slowly, comes periodically at the usual time of the menses, lasts the common time, and gradually disappears. This could never be the case in hæmorrhage from ruptured vessel. Hence then the existence of exhalent orifices in arteries is inferred.

Now, as these orifices have never been seen,* and, as I have already observed, are lost in minuteness and confusion from their number, so I almost despaired of ever seeing the orifices of lacteals and lymphatics. What made me think it at all possible, was, that these vessels sometimes take up the red particles of the blood, which are very distinctly seen in the microscope, spontaneously, and without any previous diluting power; the orifices, therefore, through which they enter must be still more visible. It occurred to me, that the place where there was a possibility of seeing them, was likely to be the villi of the intestines; a greater absorption takes place on that surface, the vessels are in proportion larger; besides, they hang out from the surface in distinct packets, and resemble hairs, or the pile of velvet, from whence they have been termed villi. The lacteals and the arteries are generally empty in the dead body, and the lacteals are collapsed and invisible, even in the living body, when there is no chyle or lymph in the intestines. The state of the villi must then be different from that in the living and absorbing intestine. Of course, they must be liable to distention and collapse. In order, therefore, to see the orifices of the lacteals, it naturally occurred to me that the villi must be in the distended state. The arteries are always empty in the dead body; and as the lacteals continue only for a little time to propel their contents after the death of the system, and are also generally empty, it must be a matter of uncommon accident to find them in the state of distention, and proper for microscopical examination. That accident, however, actually happened. A woman died, in consequence of convulsions after lying-in, about five in the morning. She had been in perfect health the preceding evening, and eat heartily at supper. The lacteals were distended with chyle, which here formed a firm coagulum: many of the villi were turgid with the same chyle, and resembled white vesicles. This was, at that time, an appearance new to me. I have since found, however, that other anatomists had seen the same thing: Bohlius, the last of the pupils of Ruysch, and a friend of Haller's, published, in 1741, a treatise, entitled, *Viæ lacteæ corporis humani historia naturalis.* Werner and

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* I did not then know that Dr. Nicholls, in his *Disquisitio de motu Cordis,* &c. had delineated the exhalants as seen in the microscope on the villi of the stomach of an ox; his words explaining the figure, are, "*duæ arteriæ, vasa secretoria demittentes,*" &c.

Feller say of him,—"prima ora, conspexit et globulos lacteos ex iis expressit,"—and that in his experiments where ligatures had been made on the trunks of the lacteals in living animals, some hours after they had been fed, "villi albi,—omnisque intestini interna superficies *albidis punctis* conspersa." Haller, after mentioning those who prior to him had seen the villi loaded with chyle, says, "Et ego inque homine villos albicantes et chylo plenos vidi." It was on these, that, for the first time I saw the absorbent orifices of the lacteals: but, before I describe them, I shall endeavour to point out what other anatomists have asserted on this subject.

Asellius seems to have seen something of the same appearance of villi in quadrupeds; for, speaking of the lacteals, and their orifices, he says, "Ad intestina instar hirudinum hiant spongiosis capitulis." His account of their orifices, from his own words, appears to be imaginary; and accordingly has been considered as such by succeeding anatomists, who, assisted by their best microscopes, could not find these orifices.—Haller, speaking of the absorbing orifices of the lacteals, concludes, "Particula de qua Ruyschius desperaverat et Lysterus et ipse demum microscopiæ artis magister A. V. Lewenhoeck."—Ruysch's words are, "Venæ autem lacteæ primi generis oriuntur ex intestinis tam subtili principio ut ineffabile id, et incredibile sit, ita quidem ut tomentosa horum exilitas absolute non possit ulla figura depingi."—Leiberkuhn has been considered by some as the discoverer of the orifices of the lacteals. Having described the arteries and veins of the villus, he comes to its lacteal, which, he says, arises out of an oval vesicle, having a little hole in its extremity. "Ramusculus vasis lactei extenditur in ampullulam vel vesiculam ovulo haud absimilem, in cujus apice forammulum quoddam exiguum microscopio detegitur." Sometimes he discovered more than one perforation in the ampullula: "Quod autem unum saltem adsit forammulum in cujusvis ampullulæ apice, certo examine mihi constat: interdum tamen licet rarissime plura, ut in papilis mammarum, vidisse memini." This ampullula he describes as filled with cellular membrane, or forming a spongy cavity. He says it has an artery and a vein opening into its cavity, and that it absorbs the chyle, and gives it to the lacteal. His account of the opening of the artery and vein into the ampullula, I have already noticed; the spongy cavity he thus describes: "Infles

per arteriam vel venam mesentericam, partem intestini per duos annulos metallicos interceptam, aditu arteriæ vel venæ libero manente—penetrabit aer, per vasa descripta, in cavum villorum; distendet hos, et ex his per forammula in apice bullularum exibit. Si cessas flando, collabuntur iterum villi; sed si continuas, quod applicatione follis facile sit, donec exsiccaveris, distenti manebunt. Tunc cultro rasorio acutissimo finde villos, et videbis microscopio, eorum cavum impletum esse materie quadam spongiosa vel cellulosa." Haller doubts his description, for he says, " Ea ampullula, quod notatu dignum est, celluloso textu videtur repleri." But presently adds, " Nisi forte circumposita fuit tela." From what I have said of transudation, the reader will easily discern how incompatible his experiments, and the conclusions he draws from them, are with what has been offered on this subject. They were made in the dead body, which permits even air to transude. The veins have certainly no open mouths on surfaces; and he confounds the whole villus, with its arteries, veins, nerves, lacteals, cuticular covering, and cellular membrane, with the imaginary ampullula. Mr. Hewson also rejects the ampullula; and, speaking of the villi of the intestines, says, " This is the only circumstance, concerning these parts, in which I should differ from this very accurate observer, whose experiments in support of his opinion, about this ampullula, seem to be liable to fallacy," &c. He not only never saw any thing, in the villi of the human intestines, like an ampullula, but, from his injections of the lacteals on the same villi of the intestines, in birds, in turtle, and in fish, where they form no ampullula, and only a net-work, like the other vessels, is strongly disposed, from the analogy, to disbelieve this assertion of Leiberkuhn's. Mr. Hewson's words are, " Since the experiments, from which the villi of the human subject were supposed to contain an ampullula, are so equivocal, and since the villi can be proved in other classes of animals, *viz.* in birds, fish, and the amphibia, to have net-works of lacteals, as well as of arteries and veins, the probability is in favour of their having the same structure in the human subject." Though Mr. Hewson rejects the ampullula of Leiberkuhn, he says nothing satisfactory concerning the orifices of the lacteals. He says, " I have some preparations by me, adapted to the microscope, in Leiberkuhn's manner, in which I think I can clearly shew the orifices of the lacteals on the extremities of the villi, where there appears sometimes to be one, and sometimes to be more orifices. In some parts of the ilium, where the injection of the arteries and veins had run more minutely, the villi appeared distended; and, instead of being broad and thin, were more round and cylindrical, and the extremity seemed spongy and porous." And afterwards he says, " It might here be objected, that these were only lascerations of the villi; but I am persuaded they were not, from having, on repeatedly examining them, observed the pores or orifices very distinct, and empty." Here it is evident, that the arteries and veins only were injected; and, as the lacteals were not, he could not say, in any other way than that of mere conjecture, what these pores were. I have mentioned the case where I first saw the villi white from the absorbed chyle. I have frequently seen them so since, but never so well as on that occasion. The observations I then made were,

1. Many of the villi were so full of chyle, that I saw nothing of the ramifications of the arteries or veins; the whole appeared as one white vesicle, without any red lines, pores, or orifices whatever.

2. Others of the villi contained chyle, but in a small proportion; and the ramifications of the veins were numerous, and prevailed, by their redness, over the whiteness of the villi.

3. In some hundred villi, I saw the trunk of a lacteal, forming or beginning by radiated branches. The orifices of these radii were very distinct on the surface of the villus, as well as the radii themselves, seen through the external surface,* passing into the trunk of the lacteal: they were full of a white fluid. There was but one of these trunks in each villus.

4. The spongy cavity, which Leiberkuhn speaks of, appeared clearly to be the common cellular membrane, connecting all the arteries, veins, nerves, and lacteals together.

5. The orifices on the villi of the jejunum, as Dr. Hunter himself said, (when I asked him, as he viewed them in the microscope, how many he thought there might be) were about fifteen or twenty on each villus; and in some I saw them still more numerous. I have, on a former occasion, described these orifices as appearing in a bulbous extremity of the lacteal;

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* The villi were otherwise transparent, and the whole surface viewed under water.

but repeated examinations of the villi, under similar circumstances, have now taught me the real structure of their orifices and primary branches. They arise out of the lymphatic glands exactly in the same way, that is, by small orifices belonging to radiated branches, which presently unite to form one vessel. Every effort I have made to detect the orifices of the lymphatics, has hitherto been ineffectual. I have looked for them on the villi of the lips, villi of the toes and fingers; but we have not there the opportunity of finding them filled with a white fluid, as in the intestines. It is also necessary here to wait the effect of putrefaction, or of boiling water, in detaching the cuticle, which makes any after appearance of course very doubtful. This circumstance, however, when it is considered that lacteals and lymphatics are the same vessels, is probably of no consequence. There may be some little variety, but the orifices and beginnings we may consider, from so great analogy in other respects, as very much resembling each other.

CHAP. XII.

Of the Coats, Irritability, Muscularity, Vasa Vasorum, and Sensibility, of Lacteals and Lymphatics.

ANATOMISTS have found, that the substance of the larger arteries may readily enough be separated into three strata; to these they have given the name of coats; and speak of an external, internal, and middle coat of an artery. The substance of which the larger red veins are formed, may likewise, though with more difficulty, be separated into coats. These coats become thinner, the farther we go from the beginning of the trunks, till at last it is no longer possible to separate them in the branches, and their existence is only inferred from analogy. Of the coats of arteries, two are commonly fibrous; in which respect they resemble the substance of the muscles: the internal coat has no visible fibres.

Till the time of Nuck, the lymphatic vessels were conceived to have but one coat, and that similar to the internal one of arteries and veins, that is, without any visible fibres. Nuck was the first who asserted, that their coats were also fibrous, and demonstrated this in the thoracic duct of horses. I have repeatedly demonstrated these fibres in the same duct, and have now an engraving of them in my possession. I have also contrived a method of demonstrating that it has at least two coats; for I inverted a portion of the duct, and drew it on a glass cylinder; the cylinder was somewhat larger than the portion of the duct, and, as I expected, the internal coat tore, and shewed the outer one entire under it. I have sometimes seen fibres in the human thoracic duct, when it happened to be uncommonly large; but more generally, even in this trunk of the absorbents, no fibres are to be seen. The muscles of the more perfect animals are all fibrous, and therefore anatomists frequently infer muscularity in parts, from the presence of fibres; but they are by no means a certain mark of muscularity. The tendons, aponeuroses, bones, cellular membrane, brain, and nerves, are all of them fibrous, but not at all muscular. On the other hand, there are many parts, such as the skin, &c. in which there is no appearance of fibres, even when viewed with our best microscopes, which are certainly capable of muscular motion. The best proof we have of muscularity in a part of a living animal, is the disposition it has to be acted upon by a stimulus, so as to be made to contract and relax every time it is applied to it. This disposition we call irritability; and the actual contracting and relaxing is muscular motion. By this test we shall be able to prove, that the lacteals and lymphatics are irritable and muscular. They not only empty themselves quickly on the admission of cold air, but, when touched in one part with oil of vitriol, or similar stimulants, contract through their whole length, as muscular fibres are known to do from such applications. Haller appears to have paid great attention to this subject, and convinced himself fully of the fact:—"Sed etiam in vivo animale, aut nuper mortuo, non solus ductus thoracicus, qui vere de genere vasorum lymphaticorum est, et perinde vasa lymphatica hepatis, ad olei vitrioli tactum contrahuntur, et celerrime exinaniuntur, sed imprimis in animale cui plena fuerunt, aut chylo, aut lympha, aut cæruleo liquore quem animalia absorbere coegi, sub ipsis intentis meis oculis, toties vidi hæc sive lymphatica vascula sive lactea evanescere: non potuerunt autem visui se subduxisse, nisi expulso qui replebat et conspicua reddebat liquore, lympha, lacte, indigo in aqua dissoluto."

to." In Mr. Hunter's experiments, the lacteals absorbed the fluids thrown into the intestines, independant of any communication by the nerves with the brain; for the trunks of the nerves of that part of the intestines and mesentery were, with the trunks of the arteries, then enclosed in a ligature. The muscular flesh of the turtle continues to contract and relax, from the stimulus of the air only, many hours after the animal's head is cut off. The absorbents appear to me to have a similar power of action, and to be capable of absorbing for some time after the animal is dead. Malpighi had before said, that one would be tempted to believe that they absorbed after death, and I was determined to make the experiment. I tied up the trunks of the arteries and veins belonging to a portion of the great intestine in an ass, which had been dead a few minutes (the intestines were still in the cavity of the abdomen, and the parts not cold.) I knew that the trunks of the absorbents must be enclosed in the ligature, though not one of them was then visible. Two hours after I returned, and found a number of absorbents turgid with a transparent fluid. I opened one of the largest with a lancet; the fluid issued in a stream, which it could not have done, unless the vessels had continued to absorb, and to propel their fluids with great force, after the death of the system.

Lymphatics and lacteals, then, have coats, which are irritable and muscular. It will be presumed, they are also vascular: we can demonstrate that they are so. That the coats of arteries and veins are themselves vascular, has been long known. Anatomists not only saw the little arteries and veins full of blood in the recently dead body, but they injected them with coloured fluids, from the cavities of the trunks on which they ramified. They termed these vessels vasa vasorum. I do not find them describing lymphatics amongst the vasa vasorum. I have seen the aorta, however, almost through its whole length, covered with these vessels, which I had injected with quicksilver. It is even usual for the trunks of the absorbents to make grooves in the coats of arteries: they are also often so numerous, as to conceal them entirely in their ramifications. The lymphatics and lacteals themselves have their vasa vasorum. I have injected, in quadrupeds, the arteries on the coats of the lymphatic vessels, and seen them ramifying very elegantly through their substance. These arteries must have their corresponding veins, and I can have no doubt of their being attended with lymphatics. The red lines which appear under the skin, when poisons are passing into the blood from the surface of the body, furnish us with another proof of the vascularity of their coats. The course of these lines, and the subsequent inflammation of the gland, show these to be inflamed lymphatic vessels. How could they inflame, if they were not vascular? It has been objected, that these red streaks alluded to cannot be lymphatic vessels, from the circumstance of their frequently having considerable breadth, whilst the diameters of the superficial lymphatics are known to be very small; but those who make this objection forget, that, though the poison enters at first one vessel only, yet, from the anastomosis of these vessels, it presently pervades a number of parallel branches, and inflaming them all, produces the breadth of the red streak. They ought likewise to attend to this circumstance, that the inflamed lymphatics, from the well-known sympathy in surrounding parts, become a cause of inflammation, not only in the investing cellular substance, but in the skin which covers them. I have sometimes, however, seen the inflamed lymphatic putting on no other appearance than might have been expected from a single vessel only being thus affected. A physician of much observation, and belonging to one of the first hospitals in town, tells me, he has seldom seen these red lines. I have seen the penis covered with them in gonorrhoea. I have now a case before me of erysipelas; on the top of the foot, the absorbents are seen inflamed and making red lines on the back of the leg and inside of the thigh, all the way to the groin, so that not only from broken surfaces, but from unbroken, and merely inflamed surfaces, these red lines sometimes rise.

Having thus considered the vasa vasorum of lymphatics, we come next to enquire whether the nerves also ramify on their coats, or what intercourse appears to take place between the absorbent and nervous system. The nerves are found either forming net-work on the coats of arteries, enclosing them in the form of rings, or making semicircular turns round their great trunks: accordingly, their actions are very much influenced by the state of the mind and brain. Thus, from a particular state of the mind, the blood is determined to the face in blushing, or called from it in fear.

In the one state it becomes red, in the other pale. Anger not only occasions a similar determination of blood to the face, but quickens and makes irregular the pulsations of the heart and arteries. The veins do not appear to have so much intercourse with the nerves as the arteries; and the reason, I apprehend, is, that the veins are more passive, and their action is in a great measure governed by that of the arteries; of course, so great an intercourse with the nerves was not necessary. The thoracic duct is surrounded through its whole length with the ramifications of the par vagum and intercostal, but what influence they have on its action I do not know. It did not appear, in Haller's experiments, that any application to the thoracic duct or lymphatics gave pain; and we have already mentioned, that the lacteals performed their functions when the nerves were tied up. Red lines, from the absorption of poison, are sometimes tender to the touch; but this is from the inflamed skin, and not from the lymphatic vessel. Wounds of these vessels are frequently accompanied with symptoms of irritation, as shivering, sickness, and vomiting, but with no other pain than what must necessarily follow from pricking some smaller nerves at the same time.

These vessels, like arteries and veins, are occasionally elongated or shortened, shoot into and ramify through neighbouring parts, and are again withdrawn: the former we infer from the circumstance of parts growing to one another, in such a manner, that the vessels of either part, though formerly unconnected, may then be injected from the other; that blood coagulating shall become vascular from the neighbouring vessels: the latter we infer from the circumstance of solid tumours occasionally disappearing in the living body, with the vessels which nourished them.

CHAP. XIII.

The Valves of the Lacteals and Lymphatics.

As soon as an absorbed fluid has got a little way within a lacteal or lymphatic, it is prevented from returning by valves. One is surprized to find, that one of the first discoverers of lymphatics was almost intirely ignorant of the valves; and that, after the vessels themselves had been described, both by Bartholin and Rudbeck, the *dilucidatio valvularum* should have been left for Ruysch. Bartholin, in his first publication on the lymphatics, says, "Valvula tenerrimæ texturæ ingressui in axilarem supra præponitur, quæ regressuræ aquæ obstat. Eaque sola observari potest. Non dubito quin alibi quoque venis aquosis apponantur valvulæ, siquidem ne flatum admittant versus extremum immissa, ob tunicæ tamen subtilem contextum, cultro anatomico separari, non possunt." Ruysch also censures Rudbeck, for being equally ignorant on this subject; though in the first edition of his works, which I have met with, he appears to me to treat of it clearly. "Intus excavata et fistulosa sunt infinitas habentia valvulas semper vesiculam chylosam sive ejus ductus adspicientia, ne humor a glandulis vel aliis partibus exsuctus iterum refluat, quod aprime ligatura ostendit." Ruysch, however, has generally been considered as, if not the discoverer, the best demonstrator of the valves. Valves are an apparatus nature employs frequently, for the purpose of preventing the retrograde motion of fluids, but no where so much as in the cavities of lacteals and lymphatics. The valves of the heart are mentioned even in Hippocrates's works. I shall not enquire whether the book περὶ καρδὶης, be genuine or not: the author, who ever he is, compares them to a spider's web, and says, οκοίον αραχναὶ: he appears also to have known the valves of the aorta, and pulmonary artery, each of which he compares to a semicircle, ημίτομα κυκλου. It is not evident that the ancients knew the valves of the veins; Fabricius was the first who engraved them, and shewed them to Harvey, who received from them his first idea of the circulation of the blood. As the valves of the arteries and veins have been considered by anatomists as productions of their internal coats, it may have been expected that I should have treated of the valves of lymphatics in the last chapter; but it never struck me as a good argument, that because one substance was seemingly continued from or went into another, it was therefore the same kind of substance; for if this was true, muscle, tendon, and bone, would be similar substances—a conclusion which needs no refutation. A lymphatic valve is a semicircular membrane, or rather of a parabolic shape, attached to the inside of the lymphatic

phatic vessel by its circular edge, having its straight edge, corresponding to the diameter, loose, or floating in the cavity: in consequence of this contrivance, fluids passing in one direction, make the valve lie close to the side of the vessel, and leave the passage free; but attempting to pass in the opposite direction, raise the valve from the side of the vessel, and push its loose edge toward the centre of the cavity: but, as this would shut up little more than one half of the cavity, the valves are disposed in pairs, exactly opposite to each other, by which means the whole cavity is accurately closed. Their loose edges are constantly turned towards the thoracic duct, or trunk of the system, so that fluids may pass towards it, but cannot escape from it into the branches. It is principally by means of these valves that we so readily distinguish lymphatic vessels from arteries and veins, or any other vessel. The arteries have none, except at their beginnings; the veins have none, or next to none, in the brain, viscera of the thorax, and viscera of the abdomen. Even on the extremities, where the veins have valves, they are never so crouded as in the lymphatics. No other vessels in the body have valves. I have said that the valves are placed in pairs; they are also frequently found intersecting the vessels, at equal distances, about the eighth or sixteenth part of an inch apart. There is great variety, however, in their distribution, in different bodies: the thoracic duct, for example, in some bodies, has perhaps only three or four pair of valves; in others, I have seen it crowded with valves through its whole length. I have seen a lymphatic vessel run six inches, without a single valve appearing in its cavity. Sometimes the trunks are more crowded with valves than the branches, and sometimes I have seen the reverse of this. It is not necessary to open the vessels, in order to discover the valves; they are sufficiently marked on the outside, and give the vessels the appearance of being notched or jointed in different places. The lacteals are generally strongly marked in this way, which makes them at times resemble a string of beads. In the lymphatic vessels of quadrupeds, this appearance is also very remarkable: nor is there the least reason for censuring Ruysch and Nuck on this subject, as having, in their engravings, very much exaggerated it. Wherever a lymphatic vessel enters a vein, there is always a valve, and most commonly a pair, to prevent the blood from passing from the vein into the lymphatic vessel. The same valves are to be observed when a lymphatic vessel joins the thoracic duct, to prevent the contents of the thoracic duct from passing retrograde into the branches. It is from this circumstance that the thoracic duct, injected with wax, appears as a trunk without any branches; and that, when injected with quicksilver, and viewed with a magnifying glass, it appears externally rough and tuberculated: the tubercules are the projections made by the valves, at the beginnings of the branches. In the red veins we sometimes meet with three or four valves, instead of two, in one place. In the lymphatics I never saw more than two; and frequently, where a lymphatic enters a red vein, there is but one valve.—The thoracic duct itself was thus described by its discoverer Eustachius, as we have seen:—" Ostiolum semicirculare in ejus origine," is the expression he employs. This I have seen in quadrupeds, but never in the human subject, where there are constantly a pair of valves. This description, however, has confused other anatomists. Haller, in particular, seems indetermined in a matter of the greatest simplicity. In his description of these valves, he says, " Ipsa autem valvula membranas habet a ductu chylifero undique in venam procurrentes ad circularis hymenis speciem, quem pro duabus valvulis potius quam pro una semilunari habeas." The vast number of valves not only distinguish and characterise the absorbent vessels from all others in the human body, but also in quadrupeds, birds, amphibious animals, fish of warm blood, as they are stiled, and even in fish of cold blood. Mr. Hewson says nothing of the valves in the lymphatics of birds, in that part of his book where he particularly describes the system; but in another part of the same book, speaking of injecting the villi of the intestines in birds, he says, " the experiment is more difficult, because their lacteals are full of valves, and their villi are small, compared to those of the turbot: nevertheless, I have succeeded, in getting the valves to give way, so as to fill a few of the lacteals distinctly enough to be seen to divide into branches upon the villi."—In the turtle they are very evident in the lacteals on the mesentery, and with some difficulty forced, by pressing the quicksilver injected from the trunk, pretty firmly, with the finger close to the valves, and in the direction of the intestines. In this way I have often ruptured the valves, without rupturing the vessels, and made the injection pass into the lymphatics of the intestines. In the porpoise, the valves of the lacteals are exactly as in quadrupeds, or perhaps still more numerous; so that it is not possible to inject these vessels otherwise than in the course of the chyle, that is, on the side of the intestines.

Mr. Hewson, notwithstanding his describing particularly the lymphatic system in fish of cold blood, was not certain whether the lymphatics had valves or not. He says, " These vessels in fish either have no valves, or the valves readily give way; for it is an easy matter to fill them contrary to the course of the lymph." I have a preparation of the stomach of a skate, in which I first injected the arteries and veins, and last of all the lymphatic vessels; but I was obliged to inject them in the course of the lymph; and the injected vessels appeared to have valves, in the same manner as the lymphatics of other animals. For my own part, I should not easily believe any vessel to be a lymphatic, where the characteristic of valves is wanting. I had once an opinion, that the intention of the valves, in the absorbents, was not only to prevent retrograde motion in the absorbed fluids, but to intersect the column of the fluid, and prevent the pressure of the whole fluids in the vessel from affecting chiefly its lower extremity; the consequence of which would be dilatation and varix at that place. I am not certain that this opinion is not well founded; for the red veins of the lower extremities, which sustain the longest column of blood, are more frequently varicose than any other in the body, those of the arm being in proportion very seldom affected. Accordingly, I conceived, that if this opinion was just, the valves would be more wanted in animals who were more frequently in an erect posture, as their lymphatics would necessarily be obliged to support a greater weight of fluids than those of animals who where generally in a horizontal position; and I thought this opinion confirmed, by finding that the thoracic duct in horses has few valves, compared with the same duct in monkies, where it is quite crowded with them. But when I came to consider, that in the turtle and porpoise, who are more commonly in the horizontal posture, the lymphatics were nevertheless crowded with valves, I became less satisfied; especially as the valves must all be open when the fluid is passing forward, and therefore the pressure of the whole column must be acting at that time.

Dr. Hunter once met with a body, where the valves were so ill adapted to the diameter of the vessels, that they allowed air to pass contrary to the course of the absorbed fluids. He inflated all the lacteals on the intestines from the thoracic duct; and, supposing that he could do this again when he pleased, neglected the opportunity of filling them with quicksilver. The same accident happened to Marchettis, according to Haller's account, who mentions it thus:—" Qui, inflato chyli receptaculo, omnia in toto corpore animalis pellucida vascula aere distendit." And he ushers in this case, by the observation of " Non semper fidæ custodes valvulæ."—He observes also, that similar, unexpected, and uncommon retrograde motion of fluids, injected into the absorbents, had happened under his own eye. He particularly mentions his having injected the absorbents of the lungs (*vasa concatenata reticulum facientia*) from the superior part of the thoracic duct. It has been very seldom that any thing of this kind has occurred to me; and, though I do not deny that it may sometimes happen in the dead body, yet I doubt very much if ever it happens in the living. In the diabetes, it has been supposed that the chyle flows retrograde from the thoracic duct into the lymphatics of the kidney; from them into the cryptæ, so into the tubuli uriniferi, thence into the infundibula pelvis, ureter, and so into the bladder. This opinion is mere supposition, depending on no experiments; and, besides that all such opinions should be rejected; why should the chyle flow retrograde in the lymphatics of the kidney, and not in the lacteals themselves? and why are not the fæces fraught with a similar fluid, as well as the urine? The arteries of the kidneys are on these occasions præternaturally enlarged, particularly those of the cryptæ, or minute glands which secrete the urine; and it is infinitely more probable, that the fluid of the diabetes arises from some remarkable change in the vessels usually secreting the urine, than from any imaginary retrograde motion of the chyle through the lymphatics of the kidnies.

CHAP. XIV.

The Lymphatic Glands.

I FORMERLY observed, that Herophilus was supposed to have seen the lacteals, because he described veins on the mesentery, which did not, like the greater number, terminate in the liver, but, *εις αδενωδη τινα σοματα*, in certain glandular bodies. These bodies are in fact, as much a part of the absorbent or lymphatic system, as the ganglions are a part of the nervous system. Scarcely have the lacteals left the intestine, and reached the mesentery, before they enter these glands. The Latin medical writers have termed them glands, from some supposed resemblance to nuts; and in our vulgar language this idea appears to be still kept up, for they are commonly termed kernels. These bodies are not only found on the mesentery, but in a great many other parts of the body. Their number is various in different bodies. As the lymphatics and lacteals, of which they form a part, were not known to the ancients, one is not surprized to find them assigning to these glands the ridiculous office of supporting, like so many cushions, the larger blood-vessels, at those places where they were dividing into smaller branches: and indeed, though we know something more of their nature, and structure, and diseases, we know no more of their real use than the ancients. As these glands inform us, however, of the passage of infectious matter into the blood; and as from their state we are enabled to judge of the presence or absence of other diseases; the knowledge of them is of great importance in the practice of medicine; and it becomes necessary to describe them on these accounts, as well as that the description of the lymphatic system would be imperfect, without a particular account of the glands. These glands are generally of an oval shape; and are of various sizes, from the twentieth part of an inch to about an inch in diameter: from disease they frequently become four or five times that size; now and then still larger. Their shape is not always oval; sometimes they are globular, sometimes round and flat, sometimes of a triangular figure; and in quadrupeds, frequently, they are collected and clustered into one mass, so as to resemble the pancreas. It was this circumstance which misled Asellius, and made him mistake the conglomeration of the lymphatic glands at the root of the mesentery, in dogs, for another pancreas; which anatomists, for some time after, distinguished by the name of Pancreas Asellii. This conglomeration of lymphatic glands sometimes takes place in the human body. I have found the lymphatics of the legs terminating chiefly in one gland, in place of terminating, as usual, in twelve or twenty, as may be seen in the figure annexed. The colour of the lymphatic glands is also various in different parts of the body, and on different occasions. In the younger animal, even on the mesentery, they have more of a red colour, and become paler with age. Immediately under the skin, they are redder than within the abdomen or thorax; and, like the external muscles, are also stronger. The glands of the thigh or arm will sustain a large column of mercury without bursting; whilst the glands on the mesentery, or on the lumbar vertebræ, easily burst. In this respect, these last resemble the viscera of the abdomen and thorax, whose texture is much more delicate and tender than that of the external muscles. The glands at the root of the lungs are commonly of a blue colour. Some have supposed this colour depended on that of the substance of the lungs, which is very frequently blue. They have said, that this substance is perpetually changing: the absorbents remove it; and, in its passage through their glands, it gives them the blue colour. I do not object to the supposition of the substance of the lungs being constantly changing, or that it is absorbed by the lymphatic vessels, and passes through their glands; but I conceive this change to take place so slowly and gradually, and in such minute particles, at the same time they are blended with such a quantity of common lymph, transparent and colourless, that it is impossible their colour can ever be owing to such a cause. The glands at the root of the lungs are also frequently black; and another conjecture has been formed, respecting the cause of their blackness. These glands, it has been said, often pour out an ink-coloured fluid, when cut into. This I have frequently seen. They allege this to be owing to the particles of soot floating in the atmosphere of great cities, which being absorbed by the lymphatics of the lungs, pass through their glands, are somehow or other detained there, form obstructions, occasion a flaccid and dissolved state of the glands, and are the cause of the blackness of their contents. This appears to me an opinion supported by no good argument. The glands are but seldom black, even in those who have lived to a great age in large cities. I should not doubt of their being black in those who have lived all their days on mountains: and the colour of the glands, in my opinion, is no more to be accounted for, in the cases mentioned, than the colour of the lungs themselves, which are sometimes red, sometimes grey, and sometimes blue. The colour of the glands may vary from the colour of the fluids at that time passing through them. Thus, at the time of the absorption of the chyle, the glands on the mesentery are whiter than at any other time—as white as milk itself. When the chyle is not passing through them, nor detained in them, they are paler; but never so red as those immediately under the skin, or on the outside of the trunk of the body. In cases of jaundice, the absorbent glands in the vicinity of the liver are frequently very yellow, from the absorption of bile. I do not recollect any case, but should believe they were also redder, when extravasated blood was absorbing from cavities, and passing through them. In scrophulous inflammation of the lymphatic glands under the skin, not only the integuments, but the glands themselves, have frequently a blue or purple colour; this is owing to the slow motion of the blood, both in the arteries and veins, or perhaps even to its stagnation in those parts, peculiar to this kind of inflammation. I have seen the blood coagulated, and giving a blue colour to the umbilical arteries of a child, who died six weeks after it was born. This blood had remained there during the whole of this period, yet in time would have disappeared if the child had lived.

The glands have been said to disappear in old age. Morgagni, Ruysch, and other celebrated anatomists, taught that the glands not only enlarged in younger animals in a certain proportion to the growth of the body, but that, after the middle of life, they gradually diminished, and at last vanished entirely. Haller also maintains the same doctrine:—"Denique etiam in hoc succo glandulæ mesentericæ cum lymphaticis conveniunt; nam et ipse exarescit per ætatem, et telæ cellulosæ filamenta nunc robustiora vascula glandularum mesentericarum adtrahunt arctantque, ut neque perinde humoribus suis perflui possint, neque ab incisore repleri, et demum strigosæ glandulæ et complanatæ cumque tela cellulosa confusæ evanescant. Dudum se absque lacteis vivere Ruyschius solebat dicere." The mesenteric glands of old people undoubtedly diminish; but that they entirely vanish, or that a period ever arrives when the lacteals cease to absorb, during life and health, as Ruysch maintained, is highly improbable. I never saw a mesentery, even in the oldest person I have opened, where the glands, though smaller, were not equally numerous with those in younger bodies. The glands in the groin, arm-pits, and neck, never vanish in the oldest bodies I have ever had an opportunity of opening.

The glands are externally smooth, and have a shining surface; this they owe to an external coat, not fibrous, nor easily separated from them. Dr. Hunter would not allow this coat to be any thing else than condensed cellular membrane, similar to that which is found between the breasts of women and the pectoralis major, and which has been described by some anatomists as the capsule of the mamma. By this coat they are connected with the surrounding adipose or cellular membrane, so as to be in a certain degree moveable; and in the groin or arm-pits, may be drawn down, pushed up, turned to one side or the other. In consequence of this sliding motion, like the testicles in the scrotum, they elude any force applied, and are less apt to be hurt. When they adhere firmly to the skin, or parts below, it is from disease. Haller makes the coat of the glands single:—" Membrana unica firma duriuscula." It has always appeared so to me. Malpighi described a second coat, consisting of muscular fibres, under the external one, whose use, he said, was to propel the fluids, otherwise liable to stagnation in the cells of the glands: but the ablest of modern anatomists have not been able to find any such fibres. A somewhat similar description of the coats of these glands has been given by Nuck. My observations on this subject perfectly correspond with Haller; who says, " Fibras autem carneas habere alii magni viri ad vota sua forte et physiologicas usus adfirment, neque oculo neque ex irritabili vi unquam confirmare potui; et manifesto video Malpighianas fibras quas membranæ externæ subjectas carnosas et reticulatas, vir magnus describit, alias ed vascula velamenti, alias ad cellulosam telam pertinere. Neque duplex velamentum reperio aut exteriorem

membranam, fibroso-tendineum et interiorem glandulæ quasi tendinem distinguo, cui fibræ internæ inserantur, quæ ad Nuckii descriptionem çum aliqua poetica amplificatione, ut ego quidem credo, fictæ sunt." This coat adheres to the substance of the gland by cellular membrane, which also connects the different vessels and particular cells with one another. This cellular membrane is pervaded by a peculiar fluid, which Haller calls succus proprius glandularum. It is principally found in younger animals, diminishes as the body grows older, and at last totally disappears. It is of various colours, more frequently white: Haller says,—" Succum, glandulis conglobatis inesse album serosum lacte tenuiorem, in juniore animali potissimum conspicuum, id quidem certum est, eum cremori similem dixit Thomas Wharton, cinereum Malpighius, diaphanum Nuckius, album Margagnius, recte, et ad naturam ut puto, omnes." In the glands of the lungs it is of a blue or black colour, but then it is from disease. This fluid, in the microscope, appears to have globular particles in it, similar to those which by the same means we discover in milk. It is most probable this fluid is there secreted by the arteries, and is totally different from the absorbed fluids, or those passing through the proper cells of the glands. Had it been found only in the glands of the mesentery, we should have suspected it, both from its colour, and containing globules, to be the chyle; but it is found in all the glands, even in those which are at the greatest distance from the mesentery, and out of the road of the chyle. Mr. Hewson suspected that these globules became afterwards the red particles of the blood. This he inferred not only from the globules, but also from the circumstance of the fluid being in greater quantity in young animals, where more blood is wanted; and its disappearing in old age, where less blood is wanted, where new parts are no longer forming, and the secretions every where diminished. The fact is, we do not know what is the use of this fluid.

The arteries of the glands sometimes arise form one common trunk, which enters at one end, and ramifies through the whole. This, however, is but seldom. More commonly the arteries are many, and come to the glands from all the surrounding parts. These ramifications are so numerous, that, after a successful injection of these with size coloured with vermilion, the gland appears like an oval lump of vermilion. I have not seen the acini, described by Ruysch, in these glands; and it would appear, that Haller also had not seen them; for, speaking of this asserted discovery, he says, "Et nescio quos acinos preterea." But, as Ruysch had not seen them in any former injection, during a long life spent in making anatomical preparations; as he has engraved the glands where he saw them; as he sent the preparation from whence the engraving was taken to the great Boerhaave; and as Boerhaave has described what he saw by the microscope in these glands; I shall quote the passage:—"Primo, quod arteriæ mesentericæ mitterent ramos suos a diversis locis versus unamquamque harum glandularum; ita ut non unus ramus peteret illam, sed varii et multi ab oppositis locis, et quod oppositis etiam itineribus et directionibus decurrentes in glandulam irent unamquamque. Secundo, quod arteriæ illæ ita a diversis regionibus missæ postquam tum venissent ad corpus illius glandulæ, ibi quasi permiscerentur inter se, quamvis tamen manerent vasculosæ, idque ubique et per omnes partes. Tertio, quod tandem subtilissimæ factæ ita confunderentur inter se, et innumerabiliorum flexuum varietate in omni puncto intricarentur, ut comparari tantum potuerint cum glomere multorum diversorum filorum in plexus inextricabiles intricatorum. Neque posse hic dici cum ulla veri specie, quod in membrana quadam ordinati hi canales in sua serie simplici possint videri. Quarto, tandem quod inter hæc intricatissima vascula et tam subtilia multis locis hæreant parvi et multi distincti acinuli ut in hepate. Et quantum oculus per microscopia assequitur, ipsi hi acinuli videntur iterum conflari ex minimis pulposis extremis plane singularibus in sua fabrica canalibus arteriosis. Nec tamen potest videri quod hi acinuli membrana quadam singulari ambiantur inclusi." Ruysch says, "Quando jam clarius et perfectius videbam, hæc omnia, præ gaudio exsiliebam." The veins of the mesenteric glands are as easily injected as their arteries, because, there, they have no valves. They come to the glands, like the arteries, from every quarter; are larger, and nearly as numerous. On the extremities, where the veins have valves, we have frequent opportunities of seeing them in the lymphatic glands, turgid with their own blood; by which means they become as distinct as if injected with a coloured fluid. There is something of convolution and interweaving also in the finer branches of the veins; so that, as Professor Mekel observes, "Vasorum igitur arteriosorum et venosorum glomer eas suspicatus Ruyschius, excretorios ductus illos putavit vasorum lymphaticorum ductus."

I have said, that the coats of the glands were not fibrous or muscular, that they shewed no marks of irritability when touched with oil of vitriol, &c. but the glands themselves are very irritable, or quickly excited to inflammation, even by applications made at a distance; for Mr. Hunter saw a case in which the skin being pricked by a needle, which never had been used before, or touched any infectious or irritating substance, occasioned the lymphatics of the arm to inflame, and shew themselves in the form of red lines, running towards the axilla; in consequence of this, some one of the glands there also inflamed and swelled; the patient had rigors and sickness; and all this in the space of a few minutes. I have also seen similar cases.

The lymphatic glands, independent of those blood vessels which form their internal substance, are generally covered externally with a minute net-work of the lymphatic vessels themselves. These glands were said, by Boerhaave and others, to be exceedingly sensible; and as he thought, furnished with a great number of nerves. The pain which accompanies the venereal buboe propably led them to form this conclusion; for it does not appear that they dissected the nerves of the glands. The only anatomical fact they seem to build on, is the great number of nerves which accompany the superior mesenteric artery. Boerhaave says, "The mesentery has but little feeling; it is not muscular. As the nerves here do not appear to serve the ordinary purposes of giving sensation, or disposition to be stimulated to muscular motion, is it not probable that they exist there on account of the mesenteric glands?"* into which he suspects they pour a fluid, which makes the chyle more fit for nutrition. Many experiments have been made, by Haller and others, since the time of Boerhaave, which render this authority, and the opinions of his time, of little weight; parts having been found with little sensibility, that were at that time supposed the most sensible of any. If the mesentery is wounded, at any part where the nerves are found, the animal screams almost as much as when the skin is wounded. Again, the nerves appear to be sent here on two very important accounts; one is, that, forming net-works on the trunks of the arteries, they may regulate the determination of blood to the intestines; and the other is on account of the sensation which was to take place in the intestines themselves, which we find in the cholic is exceedingly great. On the other hand, Baron Haller contends, from the little feeling of the glands in scrophulous suppuration, as well as from actual dissection of the nerves apparently going to the glands, that the glands have no nerves, or next to none:—“ Nervi certe perpaucs eas glandulas adeunt vix demonstrabiles etiam quando maximæ sunt. Ita neque in numerosis adeo mediastini glandulis vel unicum nervum ostendere facile fuerit, neque in thymo insigni glandula quæ mollior equidem succo tamen suo et decrescente in adultis magnitudine cum his lymphaticis glandulis convenit. Hinc obtusus harum glandularum sensus quoties tument et suppurantur, ut in scrophulis fit.” I agree with Haller, that in the natural state of the glands the nerves can scarcely be demonstrated. I do not know if they enlarge when the glands become schirrous; but I once found the nerves very much enlarged in a schirrous testicle. Walter says, the nerves sometimes perforate the glands, but go through them to other parts. “ Immo contra opinionem nuperimorum illustrium virorum, convictus sum, ad nullas glandulas lymphaticas, seu conglobatas, ambulare nervos qui in illis terminarentur; perforantur interdum glandulæ conglobatæ uno vel altero surculo uti toties mihi observare licuit sed statim ad locum proximum et ipsis præscriptum ambulant et ibi finiuntur.”

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* Academical Lectures translated into English.

Haller entertains the same opinion concerning the other glands—De nervis ita tenendum est, ut per plusculas glandulas, multi magnique transeunt, per salivale imprimis genus et lacrumale—Verum levi omnino studio percipiet quicunque verum unice sectatur, eos grandes nervos non morari in his glandulis, sed ad alias partes abire ut in salivalibus omnibus et in lacrimali glandula certum exemplum est.—No man can have a greater respect for these authorities than I have, yet I confess I cannot suppose it possible, that the nerves perforate the glands only because they come in their way; and in the examples of the conglomerate glands, given by Haller, I cannot help thinking him unfortunate in adducing the lachrymal and salivary glands, because no parts are more under the influence of the mind than the first mentioned glands, and sometimes even the second; but we know of no way by which the mind can influence mucular motion, or glandular secretion, than by means of the nerves; besides, my dissection of the nerve going to the lactrymal glands, proves that the nerve ramifies principally in the gland, and does not merely go through it, in its way to other parts. Scrophulous suppurations of the glands giving little or no pain, is, however, by no means an argument that they have not considerable feeling. In order that an inflamation shall be able to give pain, it is necessary that its progress keep pace with the rate of our ordinary sensation. If a gun bullet passes through the body with great velocity, it produces no pain, because the rapidity of the motion is greater than that which we have been accustomed to judge accurately of. Hence a soldier is shot in the field of battle, but does not perceive it at the time. On the other hand, the pressure of a hard body shall be sufficient to produce an ulcer in the skin; but we feel no pain till the ulcer is produced, because this is effected by very slow degrees, and takes up a considerable time. It is for the same reason that scrophulous suppuration of the glands gives so very little pain.

A lymphatic vessel, arising from the surface of the intestines or skin, or any other surface, and terminating in a gland, is termed by anatomists the *vas inferens*, because it brings fluids into the gland. On the mesentery, the lacteals run but a very little way before they pass into glands; not more than two or three inches in the small intestines, and sometimes not half an inch in the great intestines; but on the extremities, the vas inferens runs frequently two or three feet before it arrives at the gland to which it belongs.

A great number of vasa inferentia often enter one gland. I have seen not only those which run cutaneously, accompanying the vena saphena, but also those which run deeper, accompanying the artery, enter the same gland.

The glands, I have said, are of an oval shape. In their more common situation in the body, one end of the oval is turned towards the thoracic duct, and the other from it. The vasa inferentia enter the gland by that end of the oval which is turned from the duct. When the vas inferens comes almost in contact with the gland, it splits, or resolves itself into radiated branches, similar to those by which it originated. These, like so many fingers as it were, lay hold of the gland, and sink into its substance.

Mr. Hewson had an idea that there were lymphatics which entered the thoracic duct, without having passed through any gland; and that the duct might be injected from the great toe, without one gland being filled in the whole course of the vessels. I have injected the thoracic duct, from lymphatic vessels on the back, without injecting any gland; but I do not believe that this is possible any where else. I confess, that I have injected lymphatic vessels from the great toe, which ran along the lower extremity, and passed under Paupart's ligament, without having previously entered any gland; but if they did not enter the glands before, they always entered them at that place, or other glands in the course of the iliac vessels; and if it so happened that they passed these, they always terminated in the lumbar glands before they entered the duct. The same thing is true of the lymphatics of the arm. One may inject vessels from the thumb, which shall run along the whole extremity, without entering any gland, till they come to the clavicle; but it never happens that they terminate in the thoracic duct, or the right trunks of the lymphatics, without having first passed through the glands. Mr. Hewson meant, by this observation, to shew that the body might be poisoned by absorption of the venereal virus in the lymphatics, without our having any previous information by a buboe; and it is true, that most commonly patients have been affected with lues venerea, without any previous buboe. When this happens, it does not prove that the lymphatics carried the poison to the thoracic duct, without having previously passed through any gland; for though we know that the venereal virus must pass from the buboe in the groin to the glands on the inside of Paupart's ligament, yet there is hardly an instance of these glands inflaming and suppurating. Why the glands in the cavity of the abdomen do not inflame and suppurate on these occasions, I do not know; but it is very fortunate they do not; for if they suppurated, and the abscess burst into the cavity, suppuration of the cavity might be the consequence, and the patient would almost certainly be cut off.

The vasa inferentia frequently run under or close to the side of other glands, before they terminate in their own glands, without having the smallest communication with those glands.

The vessel corresponding to the vasa inferentia, and which goes out of the gland on the opposite side, anatomists have termed *vas efferens*, as carrying fluids out of the gland.

The vasa inferentia are almost always more numerous than the corresponding vessels going out of the gland. I have injected fourteen vasa inferentia on the thigh, belonging to the same gland; and have no doubt of there being four or five times that number, belonging to the gland, which were not injected. To all of these, one vas efferens only corresponded, which went out of the gland on the opposite side. The vas efferens goes out of the gland in the same manner that a vas inferens enters it, that is, by short, extremely minute, radiated beginnings. The vasa efferentia are generally larger in size than the vasa inferentia. I have seen some of these as large as the thoracic duct itself. They generally terminate soon in other glands; with respect to which they become vasa inferentia. Anatomists speak as if the same lymphatic vessel might pass through a great many glands, before it terminated in the trunk of the system: Haller says, " Ad quintam usque glandulam, eandem truncum lacteam quam mihi selegerem prosecutus sum." Though the vas efferens corresponds to the vas inferens, it is a perfectly distinct vessel, and the different glands are chained to one another by different vessels. There needs no other proof of this, than the instance I have already given, of one vas efferens corresponding to fourteen or sixteen, or more, vasa inferentia. The nearer we come to the thoracic duct, the vasa efferentia are larger. On this is founded the distinction of the lacteals into those of primi and secundi generis; these last being five or six times larger than the former. The vasa efferentia are not always larger than the vasa inferentia; and vessels of the same size frequently connect several glands, one after another, together.

Anatomists have been, and still are, divided in their opinions respecting the minute structure of that part of the substance of the glands, with which the lymphatic vessels are more immediately connected. One set contend, that the glands are principally made up of convolutions of the vasa inferentia;

tia; whilst others as strenuously contend that they are congeries of cells, totally distinct from the lymphatic vessels. Arguments have been adduced on both sides, from physiology, from the appearances in some diseases of glands, as well as from anatomy. Those who favour the opinion of the glands being a conglomeration of lymphatic vessels, contend, that if the absorbed fluids were once poured out into cells, they know of no power by which they could ever get out again. "Albinus argentum vivum minime in spatiola aliqua glandulosæ fabricæ effundi monebat. In ea enim cavea si aliqua hujus liquoris in massulas et guttulas effusio locum haberet, nulla porro vi credebat effectum iri ut in vasa avehentia idem resumeretur." This argument is taken from what happens in the dead body, and of course is not properly applicable to the living. If it proves any thing, it proves that Albinus was not dexterous in injecting lymphatic glands; and indeed Haller confesses as much; for he says, "Nulla vi fluidissimum metallum in lactea vasa impulsum ad totam lacteam systema, aut in ductum thoracicum, urgere potuerim, neque magis successisse vidi cum summus anatomicus Albinus id experimentum fecerit." We find at present very little difficulty in doing what Haller says they could not do ulla vi. Besides, the fluids poured out into cells may be pushed on by the vis a tergo, as the arterial blood in the cells of the placenta is pushed on into the orifices of the veins; or, the fluids may be absorbed from the cells of the gland by the orifices of the vas efferens, as easily as it was absorbed at first by the orifices of the vas inferens, from the original surface.—The arguments deduced from the diseased appearances in the glands are not more satisfactory, though they are brought to prove the reverse of the former. It has been urged, that the glands must be cellular; the uniform appearance in their diseases shew it. They degenerate sometimes into hydatids, or round vesicles; which may be easily accounted for, if we suppose cells obstructed and enlarged in the gland. Stony concretions are sometimes found in them, and these are almost always of a globular figure. Ossifications are frequently found in them, and these are always externally tuberculated; a proof, in their opinion, of their beginning in, and retaining as they encreased the figure of, the cells of the glands. In the scropholous suppuration of these glands, the pus is found cheesy and solid, in separate, and generally round cavities; which is conceived to be a farther confirmation of cells, and of its having been formed in separate cells. All of these appearances I have certainly seen; the first less frequently than any of the rest. But the argument, though originating with Malpighi, is by no means a good one. The same appearances are found in the diseases of other parts, where anatomists have not so much as supposed regular and uniform cells. In the skin, cellular membrane, amongst the muscles, in the testicle, and many other parts, the same diseases are found.—The next arguments are adduced from actual injections of these glands with quicksilver, and the appearances afterwards in the microscope. The glands thus injected, dried, and made transparent, have been subjected to the microscope; and one party of anatomists have seen, or supposed they saw, convoluted vessels only; another, principally cells. As there are very great authorities on both sides, I shall mention the principal ones, and then give my own observations.

Albinus I have already mentioned, as supporting the doctrine, that the glands consisted of convoluted vessels only. He allowed, indeed, the appearance of acini, but held them to be uninjected vessels. " Albinus autem pro vasorum glomerulis habuit in quæ liquor injectus non penetrasset, hinc observavit multos videri acinos, quando omnia vasa non repleta sunt, paucos si repleveris." He was seconded in this doctrine by the first anatomists of his age. Haller says, " Demum accuratissimi incisores Hunterus, Albinus, et Mekelius glandulas conglobati generis pro mero plexu vasorum lymphaticorum aut lacteorum habent quæ celluloso textui uniantur." Mr. Hewson also joined that class. Dr. Hunter was certainly formerly of this opinion, but changed it for many years before he died. Professor Mekel, says, speaking of the lymphatic glands, " Glandula ejusmodi microscopio contemplata nihil nisi plexus vasorum ex lymphatico vase ortorum apparet."

Mr. Hewson, in his publication on the Absorbent System, promises, in a future work, to give an account of the lymphatic and thymus glands. As death prevented him from fulfilling his promise, I collect what must have been his opinion of this matter, however, from a passage in his Experimental Enquiries, and from preparations of his injecting, which are still in the collection in Windmill Street; in which, many years ago, he observed to me, no cells were to be seen. In the passage alluded to, he hints his being of the same opinion with Professor Mekel; for he says, page 154, "The supposition of red veins opening into a lymphatic gland appears improbable, from an observation concerning the structure of glands, for which we are indebted to Dr. Mekel, viz. that they are made of a convoluted vessel." Nay, so far did he carry his idea of the simplicity of the absorbent glands, that an absorbent vessel splitting into two, and instantly uniting again, was enough, according to him, to constitute a gland. Mr. Falconer, his friend and successor, says, that the vessels splitting into four, and uniting again, constitutes a gland, which he calls the simplest he had seen, and which he has also engraved; he also describes the plexus the lymphatics make on the areolæ of the mesentery in turtle, as glands; this is an unwarrantable liberty. This appearance all other anatomists have distinguished by the name of plexus; and Mr. Hewson, in his work, expressly says, there are no glands in the turtle, &c. there is a fleshy substance, which is peculiar to the absorbent glands in all animals in which they are found, which in this plexus is wanting: the arteries, veins, and nerves, are also not distributed on these plexus as in real glands; and the making them glands seems to me an amazing stretch of the imagination in these anatomists.

In opposition to these authorities, there are also some of the first anamists.—Malpighi held, that the lymphatic glands were cellular, but in the same manner as other glands, that is, they consisted of acini. Haller says, "Marcellus Malpighius rotundos acinos, intus cavos in area fibrarum (cellulosæ nempe telæ) positos, plenos liquore pellucido cinereo in morbis vero tartareo et descripsit, et contra Nuckium non admittentem tuitus est." And again, "Et quidem in cavos suos acinos lympham utique effundi statuit Malpighius, et experimentum addit, atramentum nempe injectum in loculis morbosæ glandulæ hepatis stagnasse"—Morgagni also defended this opinion of Malpighi's. Haller in his life of Morgagni, says, on this subject, "Epistola tertia fere ad glandulas sebaceas, et ad glandulas in universum pertinet quarum et viscerum fabricam vesicularem contra Ruyschium studet confirmare et Malpighium tueri."—Nuck, though he did not admit Malpighi's acini, yet he maintained that the glands were cellular in another sense; to wit, like moss, or like the cellular membrane. Professor Mekel, speaking of this opinion, says, "Nuckius his glandulis substantiam muscosam plane singularem spongiosam tribuerit." Ruysch, I have already said, admitted acini in the structure of the lymphatic glands; but his acini belonged to the arteries, and not to the lymphatic vessels; besides, his acini were not like Malpighi's, hollow, but a globular subdivision of arteries into minute branches. Haller says, "Et ipse Fredericus Ruyschius acinos nonnullos glomerulorum similes depinxit, verum caveos esse aut liquorem continere idem negavit."

Haller describes the lymphatic glands, in one part of his work, as cellular, in the manner Nuck had described them, and admits their spongy texture, "ex fibris non cavis recte fieri Nuckius docuit." He there speaks of their structure as very simple: "Fabrica mihi valde simplex visa est, quam insigniter complicatam et difficilem varii etiam bonæ notæ scriptores faciunt."

And accordingly, speaking of the lymphatic glands of the mesentery and mesocolon, in one place he says, "Iterum ut vasa lymphatica ad suas glandulas ita ad mesentericas lactea se habent. Quando enim ad glandulas utriusve mesenterii pervenerunt unico trunculo, aut potius pluribus, dividuntur pariter in ramos, inque cellulosam naturam glandulæ ramos amittunt ramosos tot et tantos, ut tota glandula in capellis etiam potissimum ampulla lacte plena videatur, neque facile sit acum figere quin de vulnusculo lac exstillet." Here every thing seems clear and easy; but in the very same page he says, "Difficile est dictu, num in ejusmodi glandula lactea vascula continuo maneant, num potius chylus in cellulosam telam deponatur, et ex ea per ductus efferentes iterum resorbeatur—anatome hic nihil definit." And in another volume of his works, still on the same subject, he says, "Verum omnino difficile est definitu, num lympha vasculorum advehentium unice in revehentia resumta transeat, num potius in aliquas glandularum caveas prius effundatur, ex quibus per revehentes ductus resorbta exeat?"—And, having at last adduced the authorities on both sides, for and against the cellular structure of the glands, he then endeavours to reconcile them: "Neque impossibile videtur utramque sententiam conciliare. Cum enim in omnibus glandulis conglobatis pariter in mesentericis juniorum animalium succus serosus etiam lacteolus sed tenuior reperiatur, poterit fieri ut lactea quidem vasa prima cum secundis continuentur,

entur, ceterum arteriæ eum cremorem in glandularum cellulosa spatiola deponant, minimæ vero venæ resorbentes eumdem resumant, inque secunda lactea sive in truncos efferentes revehant."—From what has been said, it will appear, that it is no easy matter to unravel the structure of the lymphatic glands. I shall faithfully relate what has occurred to me, having been very much versed in injecting these glands with quicksilver. If the glands are compleatly injected with quicksilver, and then examined in the microscope, it is certainly true, as Professor Mekel has observed, that nothing but convolutions of lymphatic vessels are to be seen in many instances; but it is as true, that after the most successful injections of these glands, the cells have been seen perfectly distinct. I have injected many glands, where there was not the least appearance of a convoluted vessel, and where the radiated branches of the inferens and efferens, with intermediate cells only, were to be found; but I never injected a lymphatic gland, where I did not see some cells, particularly if I was attentive to the mercury just as it entered the gland. Accordingly, one of the best methods of shewing these cells, is stopping the injection after the gland is half filled; the cells are then exceedingly evident. But if the injection goes on, the cells are covered over with ramifications of finer vessels, entering those cells, and injected contrary to the valves. I have injected these into the surrounding cellular membrane itself, in the human subject. In quadrupeds it is very easy to demonstrate the cellular structure: both in asses and horses the glands on the mesentery are most distinctly cellular, as will be seen in the annexed engravings. In the former, the cells are distinct, without any other dissection or preparation of the glands than merely injection; but in horses it is necessary to dry them, and afterwards lay them open; the cells then appear like those of a honey-comb, and bristles may be passed from one set into another, by lateral perforations, as is seen in the plates. When there is but one vas inferens and one efferens, there is but one set of cells; but when there are many, each appear to have their proper cells; and these cannot be injected from the other cells, but only by their own inferentia.

It has been alleged by some, that cutting into a lymphatic gland, and observing the appearance of cells, is no proof that it is actually cellular. In this way the vesiculæ seminales appear cellular; and yet Haller proved, by maceration and dissection of the cellular membrane only, that they could be drawn out into the form of small intestines, or straight tubes; and that it was convolution only, and connection of cellular membrane, which made them put on this appearance. Now, say they, may not the lymphatic glands appear cellular, and yet really be convolutions of vessels? In the first place, it is not possible to do the same thing with these convolutions, supposing them to be such, as Haller has done with the vesiculæ seminales. In the next place, though I allow that even in the lymphatic glands of the horse, which are here exhibited engraved, there is something of the appearance of a twisted vessel in the outside view, yet it can never be supposed to be the entering vessel which is thus convoluted, as its diameter is fifty times that of the radiated extremities of the inferens. Again, no convolution of vessel only, can ever account for the lateral communication of some cells, and there being no connection between others.

CHAP. XV.

The Ramifications, Anastomoses, Number, and Size, of the Lymphatics and Lacteals.

The common appearance of arteries and veins, is that of trees sending off branches; and the term anatomists employ to express this appearance, is *ramification*. Every body knows that the branches of a tree are commonly sent off, at acute angles, to the trunk; so are the branches of the trunk of an artery: and the reason of this seems to be, that in making an acute angle, they deviate less from the straight line of the trunk, and of course less opposition is made to the current of the blood. Dr. Hunter would not allow that the branches of arteries made a right, much less an obtuse, angle: they sometimes seemed to do so, but this was a deception that in the living body, and even in the dead, previous to any dissection, or removal of the connecting substance, the cellular membrane, which in many instances so evidently determines the shape of parts, they would always be found forming acute angles:—though this is not always the case, it is very frequently so. The lymphatics ramify pretty much in the same manner as the arteries. The veins ramify as the arteries do, to meet their extremities, to receive their blood. The lymphatics lie on the trunks, and branches, of the arteries, to receive protection and support from the stronger vessels: but though this is frequently the case, there are great exceptions to this rule, and what Haller says of the nerves, is also true here: "Anguli omnigeni." Their branches in sôme parts are vastly more numerous, and closer together, than those of the blood-vessels. This appearance is frequently to be met with on the external surface of the liver. On the extremities they run in the form of long parallel tubes, apparently without ramifying; on more careful examination, however, I find that this is a deception; that they certainly do ramify, though not so much as on the liver; and the reason why they appear not to ramify is, that a pair of valves are almost always placed at the beginning of every branch, which hinders the injection from passing down. I formerly observed, that this appearance was to be found in the thoracic duct, the trunk of the system itself. Lymphatic vessels, however, frequently do run a long way without ramifying at all; sometimes two or three feet, or more. This is different from any thing we find in arteries or veins. The carotids run six or eight inches sometimes, and the iliacs nearly as much, without ramifying: but except the arteries and veins of the umbilical cord, there is no other instance of the blood vessels running so far without branches. The lacteals form a deep-seated and a superficial set; these last are very irregular in their course, and seldom appear to ramify; the former in their mode of ramifying, are not to be distinguished from the arteries and veins, and run exactly parallel to them. The larger lymphatics of the lungs have something very peculiar in their appearance, and in general resemble a fishing-net: the areolæ of this larger net-work are filled up with a finer and more intricate net-work of smaller lymphatics; so that the whole external surface of the lungs may, in a very successful injection, be seen covered with lymphatics. In general, we only inject the courser net-work; the areolæ of which, lying in the interstices surrounding the small lobules of which the lungs are composed, are generally of a square figure. This net-work was noticed by Haller; who expresses the appearance by the words "Vasa concatenata reticulum facientia." In the lungs of the turtle, the lymphatics form a similar net-work; but in the lungs of many quadrupeds they ramify, in the usual manner of arteries and veins, without forming any net-work resembling that now described. In the intestines of the turtle, there is also a very fine net-work of parallel vessels, situated between the muscular and villous coat. When this is injected with quicksilver, and the intestine fully inflated and dried, the mercury appears as if extravasated into the cellular membrane, though more regular and uniform; but if, after having injected the net-work, the intestine is inflated only to one third of its diameter, the cylindric vessels forming this net-work, and which are every where of the same diameter, become extremely distinct. I believe that these vessels communicate with one another, either by exceeding short branches, or lateral foramina; for the whole net-work fills immediately and uniformly, after the mercury has once entered it. A similar net-work is to be found on the spleen in calves.

The branches of the arteries in the human body so unite with one another, that the arteries of almost the whole body may be injected from any one of the branches. This communication between the branches of the arteries is termed anastomosis. The branches of the lymphatics and lacteals also anastomose; so that, did not their valves prevent retrograde motion, what was asserted of the arteries might be also asserted of them; that by a pipe introduced into any one of the branches, the greater trunks of the system might be injected. This anastomosis takes place not only between the smaller branches, but between the larger trunks and the glands themselves. It is thence that very many lacteals and glands, and even the thoracic duct itself, may be filled from one lacteal on the intestine. From one lymphatic on the top of the foot, a considerable number of other lymphatics on the leg and thigh, the greater number of the glands in the groin, on the edge of the pelvis, on the vertebræ of the loins, and the thoracic duct itself, may in the same manner be injected. From one absorbent on the external surface of the liver some hundred of the superficial set may be filled, and a great number even of the deep-seated ones. It has sometimes happened, that nearly half of the absorbents of the lungs have, in the same manner, been injected from a single aperture in any one of the lymphatics, on their external surface. Some years ago I discovered an anastomosis between the lacteals coming from the mesentery, and the lymphatics of the liver and diaphragm; and, in consequence of this communication, was able to demonstrate, at lectures, some hundreds of lymphatics on the upper surface of the diaphragm turgid with white chyle. In the intestine of the turtle, if the quicksilver can be made once to enter the net-work, all the lacteals of the intestines and mesentery may be injected from it; and on the lungs I have, from one vessel, actually injected all the lymphatics of a whole lobe. The intention of nature, by these anastomoses, is evidently to secure a number of roads, by which these important fluids, the chyle and lymph, may be carried into the blood. In the instance I have mentioned, of the anastomosis between the lacteals and the lymphatics of the liver and diaphragm, the chyle, it is evident, may get into the blood, were the thoracic duct itself obliterated; for the lymphatics of the diaphragm pass under the sternum and cartilages of the ribs, to the angles between the jugulars and subclavians of both sides.

Asellius has represented the lacteals in quadrupeds as numerous on the mesentery as either the arteries or veins; and anatomists in general have allowed his representation to be just. In the human intestine, those which I call the deep-seated set, are exactly double the number of the arteries or veins: for every artery is attended with one vein and two lacteals: the artery and the vein lie in the middle, and the lacteals one on each side; besides these, however, there is a superficial set remaining under the peritoneal coat of the intestines, so that the lacteals are three times, if not four times more numerous than the arteries and veins. In the intestines of the turtle, if the net-work is included, the number of the lacteals, in proportion to the arteries and veins, is still greater; so very much so, that I am tempted to suspect that they do something else than absorb chyle or lymph. Though the lacteals were allowed to be so numerous in many animals, anatomists in general did not believe that the lymphatics of other parts were in proportion numerous. I have already quoted Haller's sentiments on this subject, declaring that the lymphatics were by no means, in point of number, to be compared with arteries, veins, or nerves; and a physiological writer has termed them a trifling appendage of the red veins. In my dissections, I have found more lymphatics than either arteries or veins, in such parts of the body where I have succeeded well in the injection; and I have no reason to doubt but they are as numerous in the other parts.

In the extremities of the human body, the superficial lymphatics are vastly more numerous than the cutaneous veins, fourteen trunks frequently accompanying one cutaneous vein: and the deep-seated lymphatics are at least double of the arteries they attend, every artery being commonly accompanied with two red veins and two lymphatics. On the omentum of the turtle, the lymphatics are more numerous than the arteries in the proportion of four to one; and superior to the veins in the proportion of four to two; the arrangement being constantly thus: an artery lies in the middle, between two lymphatics; two red veins lie on each side of these last; and two other lymphatics on the outside of the veins. I once injected the lymphatics of the skin by accident; for the mercury ran contrary to the valves. The portion of skin thus injected was small, but the lymphatics were very numerous in proportion; and, from what I then saw, I could have no doubt of the lymphatics being as numerous on the surface of the skin, as they appear on the surface of the intestines.

In the arterial system, there is a certain proportion kept up between the trunk and the branches; any one of these last being smaller than the trunk, and the branches in general gradually diminishing in size, by branching afresh, in proportion as they recede from the trunk. There is a good deal of this appearance even in the venous system, though not so regular throughout; the right jugular, for example, being commonly twice the size of the cava superior, its trunk, and the left jugular often twice the size of the left subclavian. But in the absorbent system, the disproportion between the trunk and branches, in point of size, is exceedingly remarkable. I have seen one of the efferentia from a gland in the groin larger than any part of the thoracic duct, except its beginning and termination, where it is generally largest. I have seen the trunk of the lacteals equally large. One of the trunks of the lymphatics of the lungs, which I had injected with quicksilver, was twice the size of the duct, as it lay behind the root of the lungs, on the spine. Two of the trunks of the absorbents, in the lungs of an ordinary-sized turtle, were each of them as large in diameter as the cava superior in the human subject, and ten times the size of the thoracic duct they belonged to, if the receptaculum chyli be excepted.

There is in the branches themselves a peculiar appearance, connected with their size; this appearance sometimes is to be found in the red veins; it is then the effect of disease, and we say they are varicose; but it is natural to the lymphatics, particularly in certain parts of the body, and in certain animals. The lymphatics of the legs, liver, and diaphragm, in the human subject, frequently put on this appearance. It is almost always to be found, and that in a very great degree, in the lymphatics of the spleen of a bullock. The vessels appear large at one place, presently contracted to one fourth of that size, and then suddenly dilated again; and thus alternately, like a chain of vesicles joined by very small links.

CHAP. XVI.

The Situation and Course of the larger Absorbent Vessels.

HIPPOCRATES himself seems delighted with the solicitude of Nature, in contriving a place of the greatest security for the axillary artery, on its emerging from the cavity of the thorax,—αὐτὴ δε παχέιν διὰ της κληὶδος καθήκει ὑπό τὴν ὠμοπλάτην;—for this large vessel is placed between the clavicle and scapula, τῆ μὲν γαρ αὐτεὴ νεῦρον περιέχει πλατύ τῆ δε χόνδρος.—It has a large nerve on one side, and a cartilage on the other,—ἀσάρκȣ δε ἐόντος τȣ̃ τόπȣ ῥηϊδίως ῥήγνυται;—for this part having no muscles around it, the vessel otherwise would have been easily tore.

Dr. Hunter also, in his Anatomical Lectures, was at much pains in pointing out the wisdom of our Author in disposing of the larger arteries and nerves: great part of the reasoning he then employed, will apply well here;

but there are some other reasons for the position and course of the larger absorbent vessels, which do not apply either to the larger arteries or nerves.

In the arms the larger arteries and nerves are on the inside, and have the bones between them and external accidents: in the legs the arrangement respecting the chance of injury, is exactly similar. The larger trunks of the absorbent vessels, in both extremities, are situated on the trunks of the arteries.

In the arms and legs the arteries lie on the bending side of the joints, by which means they are adapted to the *figura media*, or the middle state of the limb, between full flexion, and full extension; in short, that state in which a child is found in the womb during the latter months of pregnancy, and into which we naturally throw ourselves when asleep, and in bed: the consequence of this arrangement is, that the arteries are not extended in extending the limbs, and have not, of course, their diameters diminished, which would have been the case if they had been placed in the reverse situation; the freedom of the circulation of the blood, through them, is thus perfectly preserved. The principal trunks of the absorbents, for the same reason, are situated on the larger arteries.

The arteries, according to Dr. Hunter, took the bending side of the joints on the arms and legs, because it was the shortest road to their places of destination, the aorta lying on the lower vertebræ of the loins; the shortest road to the thighs was under Paupart's ligament; the shortest road thence to the calf of the leg was through the ham, and to the sole of the foot, behind the inner ankle; the shortest road to the arm was evidently by the axilla, and so afterwards as in the legs. The larger absorbents here also for the same reasons, follow the same course.

Haller also supposed, that the absorbents follow the course of the arteries to receive an additional impulse from their pulsations in their diastole, but as they suffer equal retardation by the division of the stream of their fluids before they can receive their impulse, this reasoning is liable to great objection, if not totally erroneous.

The reasons assigned may be sufficient to account for that distribution of the principal trunks of the absorbents, in which they are joined to the principal arteries on the extremities. But many, and indeed most of the second order of trunks of the absorbents on the extremities, lie with the cutaneous veins, with the *basilic* and *cephalic* veins, and their branches in the arm, and with the *saphena major* and *minor*, and their branches in the lower extremity. Some reason ought to be given for this arrangement: the same reason which is given for the existence of cutaneous veins, will apply equally well for the existence of these cutaneous lymphatics; the cutaneous veins serve to transmit the blood to the heart, under the circumstances of the violent and continued action of the surrounding muscles of the limbs, when of course, the deep-seated veins must necessarily be compressed, and the circulation of the blood through them be nearly altogether prevented; these cutaneous veins also serve other purposes, for we find them transmitting a larger proportion of blood during the summer, whether the muscles are in action or not; and they may serve other purposes yet unknown. For similar reasons I have not the least doubt that the cutaneous absorbents follow the course of the cutaneous veins.

The larger absorbent vessels frequently run by themselves, at a distance from any larger artery or vein; this circumstance Haller also has noticed, and it was this that induced him to give them the name of "*vasa solitaria*." Why they do this I do not yet know: retardations of the absorbed fluids may be necessary in parts, or at times, in the whole of the absorbent system; the infinity of convolution in some parts of this system, makes this supposition at least probable. The absorbents on the liver, lungs, heart, &c. run in greater numbers on the external surfaces of these viscera, apart also from arteries and veins, and form a distinct and peculiar appearance, perhaps for the same reason as the last mentioned vessels; this circumstance alone has often enabled me to discover them. There is much variety in nature, however; I have seen the liver without a single absorbent appearing on its external surface, and I have seen the arteries occupying all that surface usually occupied by the absorbents. The larger absorbents are also found running on the broad ligaments of the uterus, ligaments of the liver, ligaments of the lungs, as the anatomists affect to call the passings of the peritoneum and pleura from these viscera to the neighbouring parts. No other reason can be given for this, than that if the absorbents are not to run with arteries and veins, they are in greater security by passing along these ligaments, which are stronger, than if they passed unprotected by themselves. Lastly, the *great trunk* of the absorbents lie with the great artery and vein, the *aorta* and *cava inferior* on the spine, till it reaches the heart, after that with the æsophagus, also on the spine, and under the clavicle, almost to its termination. Another *great trunk* lies immediately under the sternum, and a *third* also lies on the right side of the spine, above the heart, and under the clavicle to its termination; these are all places of the greatest security, both from wounds, laceration, and from compression.

CHAP. XVII.

The Termination of the Lacteals and Lymphatics.

WHAT follows, is to be considered as chiefly applicable to the human body. Some of the arguments will apply equally well to quadrupeds, and to the other classes of animals; but my principal object, from the beginning, has been to describe the absorbents of the human body: and now, that I am come to consider the termination of these vessels, I wish to adhere more strictly to this principal object. When anatomists speak of the termination of lymphatics and lacteals, they are to be understood in a threefold acceptation. In the first place, they say, lymphatics or lacteals terminate in glands. In the second place, they say, that they terminate in the thoracic duct, or in the second trunk of the absorbents, situated on the right subclavian vein; or, lastly, they say, the ultimate termination of lacteals and lymphatics is in the subclavian and jugular veins. I have already minutely described the glands, as they appear to me more connected with the general history of these vessels. I proceed now to give some account of the two great trunks of the absorbents, reserving the particular description to the second part of this treatise; as also to enquire into the reason why these trunks terminate at last in the veins, and in that particular part of the venous system where they so uniformly terminate in all animals where they have yet been found, and particularly in men. Some of the causes which have been assigned for this structure are only applicable to the human subject in its erect posture; but the anatomists who have assigned these causes have forgot that a half, or at least a third of our life, is spent in an horizontal posture. Perhaps one of the uses of sleep, and of the horizontal posture during that period, may be to facilitate the introduction of the chyle and lymph into the blood. However, as the human subject is more frequently in an erect posture, the reasons for the termination of this system shall be considered in that point of view. I have already said every thing that I thought necessary respecting the termination of lacteals and lymphatics in glands. The terminations of these vessels in the receptacle of the chyle, as engraved in the works of the most celebrated anatomists, are imaginary and false. The fact is, the thoracic duct has not yet been well delineated by any anatomist; they seem to have had no true conception of its extent; and very little, indeed, previous to Mr. Hewson, was known of the second trunk. The thoracic duct in the human subject is formed principally from three great vessels; one of these corresponds with the right leg, the other with the left, and the third with the lacteals of the small intestines. This duct is frequently one fourth of an inch in diameter at its beginning; it is sometimes about half that size in diameter near its termination; it is frequently not more than a tenth of an inch in diameter about its middle, at other times double or triple that size at the same place. It commences about the third vertebra of the loins, reckoning from above downwards; it there lies on the left side of the spine, under the aorta; afterwards it runs to the right of the superior vertebræ of the loins, and along the right side of all those of the back, except the four uppermost, where it passes to the left side; after which it emerges from the cavity of the chest; and, running about an inch or more above its destined termination, it forms an arch, and runs downwards, to enter the veins in the angle between the jugular and subclavian of the left side. There are valves found, in greater or lesser number, through its whole course; there are, particularly, a pair of valves at its termination in the angle mentioned.

The thoracic duct in the human subject may be sixteen, eighteen, or twenty inches in length. The second trunk of the absorbents, or that which terminates in the jugular and subclavian of the right side, is frequently not more than a quarter of an inch in length; it lies upon the superior surface of the right subclavian, and terminates in the angle between it and the jugular of the same side; its diameter is not inferior to that of the thoracic duct, at the same place, on the opposite side. Why the lymphatics and lacteals terminate first in glands, I have perhaps explained. Why they terminate, after this, in two large trunks is very evident: in the first place, the larger the trunks are, the stronger are the muscular fibres; in the second place, the greater is the bulk of the fluids: in consequence of both these circumstances, the more certainly will the absorbed fluids overcome the resistance made to their entrance into the subclavian veins by the blood. Why they terminate at last in the jugular and subclavian veins is also very evident; for in the veins, the motion of the blood is slower, and the resistance, of course, less than it would have been in the arteries. Why they terminate in the angles between the jugulars and subclavians, is also evident; for the resistance of the blood to any fluid entering the veins must be less, as that blood comes nearer the heart. Why they enter at the angle is also evident; because the columns of blood in the jugulars opposing those of the subclavians with nearly equal force, the venous blood at this place must flow in the diagonal between the beginnings of these two veins, and the absorbed fluids, of course, in the same direction as the current of blood in this place. The reason of the thoracic duct forming a curve, and descending to its termination, would seem to be to give its fluids the advantage of their gravity, by which they may more easily overcome the resistance made to their entrance by the venous blood; but they would lose more force from altering their direction, than they would gain by this addition from their gravity. The absorbed fluids are not discharged into any other veins; and the reason of this is also evident; for, from their greater accumulation in the thoracic duct, their momentum is increased, and they are enabled more readily to overcome the resistance from the venous blood. The reason also why they do not terminate nearer the heart, or in the cava superior, is also evident; for then, every time the right auricle contracted, more resistance would have been made to the entrance of the absorbed fluids into the veins, as there is not only always more or less retardation of the blood's motion in the cava superior, every time the right auricle contracts, but there is even retrograde motion, which is greater in proportion as the blood is nearer the auricle. Thus the thoracic duct, and the second trunk of the lymphatics, are both inserted with the greatest possible advantages. This last argument, as well as that adduced for the termination of the lymphatics in the angle between the jugulars and subclavians, are those employed by Dr. Fordyce. The reason also why the thoracic duct is inserted into the left subclavian, in preference to the right, seems to be not merely that the former is nearer the duct, but because the fluid coming from the left subclavian is not in so direct a line with the cava superior as that from the right subclavian is; the retrograde motion in the blood, on the contraction of the auricle, will, of course, affect it less. That part of the left subclavian, lying under the sternum, slopes gradually towards its insertion into the cava superior; and the absorbed fluids, both in the erect and horizontal position of the body, from this circumstance, descend, assisted by their own gravity, into the heart. Morgagni employs a similar argument for the termination of the thoracic duct as now described, and against the propriety of any other termination, viz. If the lymphatic vessels had been inserted into the cava inferior, they would have increased the quantity of fluids in that vessel mounting upwards against their own gravity. This argument, he says, was first suggested to him, from Cowper's reasoning on the propriety of nature's forming the vena azygos; which, he says, was in order to diminish the quantity of blood, which otherwise must have mounted upwards in the cava. Morgagni's words are, "Quam quidem sententiam cum mihi ea primo cognita est, non parum fateor placuisse, sive quod revera habeat cur placere debeat, sive quod similes ob causas ipse olim conjecissem thoracicum quoque ductum, non in proximam venam cavam inferiorem, sed in ramum superioris influere."—Haller not only supports the propriety of the terminations as we have described them, but he combats the doctrine of those anatomists who maintained other insertions of lymphatics into red veins. Professor Mekel, in particular, warmly contends for such termina-

tions: " Non raro mihi in repletione vasorum lymphaticorum mercurii ope occurrit, liquidum hoc penetrabilissimum absque extravasatione ex vasis lymphaticis in venas sanguiferas transiisse. Hinc cavam venam inferiorem ex injectione in vasa lymphatica mercurio plenam inveni—Insertam in venæ portarum ramum gastricum lymphaticum vasculum observaveram, cujus communicationis in Epistola mea de Vasis Lymphaticis jam ante plures annos mentionem feci. Simili causæ repletionem venæ cavæ per vas lymphaticum incognitum mihi tribuebam." Haller's reasoning on this subject is so excellent, that I shall lay it before the reader in his own words: " Nullum testimonium, dissimulavi, neque non moveor magno præcipuorum virorum consensu. Sed aliæ et satis graves rationes sunt, quæ mihi hoc totum lymphaticarum venarum cum rubris commercium dubium reddunt et suspectum. Expendi quam vicinas venas rubras lymphatica lumborum pelvis testiumque vasa habeant, quam remotum inde ductus thoracici in venam subclaviam sinistram patentis ostium sit, et existimavi mirum omnino naturæ consilium fore per immensam longitudimem eam lympham sursum ducentis, si omnino non contrarium est ejus aut mori aut legibus in venas rubras lymphaticos ductus immittere. Sed etiam certo satis novi hepatis vasa lymphatica adeo numerosa, neque cavæ venæ neque illi immitti quæ ad portas tendit. Ramorum etiam lymphaticorum certa fide ex omnibus corporis animalis partibus in truncos sensim majores, hinc in ductum thoracicum confluxus, manifestam inter eum ductum cavamque venam similitudinem constituit. Porro ad naturæ constantem analogiam animum adhibui, quæ nusquam minimas etiam rubras venulas in maximos truncos immittit, sed in venas colligit sensim majores donec proximæ magnis suo lumine sint in quas terminantur.—Iterum ductus chylifer proximam in abdomine venam cavam manifesto præterit, et remotissimam subclaviam eo valde probabili consilio petit, ut capiti, collo, artubus superioribus propior accedat, earumque partium recipiendis lymphaticis venis se accommodet. Addidisse liceat, nunquam me vel unicum vasculum reperiisse quod vera fide in venam rubram terminaretur, neque me absque consentientibus cl. viris eum vasorum aquosorum terminum rejicere. His omnibus pensitatis, valde mihi probabile fit omnem ex corpore humano redeuntem lympham prius in thoracicum ductum confluere quam sanguinis massæ reddatur, ita

et facilius in sanguinis contrarium torrentem se sua mole penetrat.''—Great part of the reasoning employed in pointing out the propriety of the insertion of the thoracic duct, is applicable also to the propriety of the insertion of the second trunk of the lymphatics; though, at the time Morgagni and Haller wrote on this subject, it was less known. I have only to add, in confirmation of their doctrine, that during fifteen years of incessant attention to the injecting of lymphatic vessels, I never saw one inserted into any other red veins than the subclavians or jugulars.

CHAP. XVIII.

Conclusion of the First Part.

HAVING examined the structure and properties of the lacteals and lymphatics, I shall conclude with a review of their different functions; from whence their importance in the animal machine may be collected.

I have said, that these vessels carry fluids into the blood-vessels, and there is no fluid in the body which they do not occasionally carry into them; but those which more peculiarly belong to them, are the chyle and lymph. It will be expected, that I should say something of the properties of these fluids, and of what importance it is to the animal machine that they should be absorbed and carried into the blood-vessels.

In the first place, the chyle is the fluid into which our food is converted, in the stomach,* duodenum, and, perhaps, in the jejunum and ilium; and which is afterwards absorbed by the lacteals, and carried into the blood-vessels. The importance of this fluid is obvious, as it is well known, that if the stomach is prevented from receiving food, and the chyle, of course, is not formed, nor absorbed, the body wastes, and the animal soon dies.

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* Dr. Fordyce in his Gulstonian Lecture, endeavoured to shew that the chyle itself did not begin to be formed in the stomach.

On the contrary, when the stomach receives and digests the food properly, and the chyle is formed, and nothing prevents it from being absorbed, the body is nourished and supported. I am confident that this fluid cannot be formed any where else than in the stomach and duodenum, or small intestines; and that it is the only fluid which can properly sustain life in man, the mammalia, and birds. Glysters of milk, broth, and what are commonly called nutritious fluids, may be detained in the rectum, may be absorbed from it, and will support the body for some little time, in cases where no nourishment can be given by the mouth; as, for example, in strictures and paralysis of the œsophagus, exostosis of the vertebræ of the neck behind the pharynx, and in the locked-jaw; but I have not known any patient supported longer than three weeks by glysters only, excepting in one instance, mentioned hereafter. Perhaps warm baths of such fluids as are commonly used for our food would also support the body for some little time; and Paracelsus is said to have actually kept men alive for some days by this method: but the reason why they do not support the body for any length of time is, that the rectum cannot convert these fluids into chyle; neither is there any property in the surface of the body which can produce this effect.

The chyle in men and quadrupeds is of a white colour; in birds and fishes it is transparent, and resembles water. Taken from quadrupeds, it commonly tastes salt, and has no sensible smell. Haller says that it is acid, by which means it corrects the tendency to putrefaction in the blood. His words are, "Utilitas chyli proxima est, putrescibilem naturam sanguinis acido succo suppeditato contemperare. Absque chylo enim, ut ostensum est, omnes succi humani in summam acrimoniam transeunt, et febris accenditur, intra paucos dies funesta." I never could perceive any marks of acidity in it, by tasting it, smelling it, nor by effervescence from mixture with salt of tarter, or changing paper, dyed purple with the juice of blue flowers, into red: and the effects, that he attributes to the want of the acid of the chyle, are much better explained from the debility which want of food must produce in the body. The jail-fever, for example, attacks the strongest persons, and produces universal debility, or depression of strength, from the moment of its first attack; and, in consequence of this, the srongest symptoms of putrefaction of the fluids appear in a few days. Viewed in the microscope, the chyle appears to contain globules, which are all of the same size; smaller, considerably, than those of the blood, and resembling the smallest globules found in cows milk. If the animal, from which the chyle is taken, happens to be in full vigor at the time, the chyle coagulates wholly in the vessels into which it is received. If an animal in full vigor is killed at the time of the absorption of the chyle from the intestines, the chyle will be found firmly coagulated in the lacteals. It coagulates in the same manner in the lacteals of the human subject; and it is in consequence of this firm coagulation that I have been enabled to lay before the public the annexed engraving of the human lacteals and their orifices. In weaker animals, the chyle coagulates only in part, whether it is in the lacteals of the dead body, or received into a spoon from the lacteals of the living body. In this last instance I have found the crassamentum floating on the surface of the uncoagulated part; a circumstance in which it resembles blood in a similar situation. Perhaps the chyle would always separate into two parts, if a sufficient quantity were taken; as blood coagulates wholly when received into a small vessel, and always separates into two parts, if received in a larger quantity in a large vessel. I have kept chyle a great many hours, even two days, in the heat of summer, without its becoming putrid. Haller's account of the chyle is " Est in chylo lactis natura, color certe idem et gratus sapor subsalsus—Levis est, ex oleosa natura, cum aqua intrita et sanguini innatat et ipsi sero; fluidior tamen: sed ipse cremorem habet innatantem; facile ut lac cogitur—In eo chylo aqua est, et multa pinguitudo butyrosa, globulorum figura—Acida natura in chylo dominatur, ut sibi permissus sponte acescat, et aliquando in animalibus acidus fuerit sapor—tamen is acor hactenus pinguedine obvolvitur ut succum heliotropii nullo tingat rubore—Super ignem coctus chylus rubescit, et adfuso vini spiritu, ipse aut rubrum aut flavum colorem in chylo nunquem reperi—Non nigricat cum gallis; etiam quando sal martis sumptus est, nascitur in intestinis intra duas, tres, quatuor, quinque, vel sex horas." This fluid is absorbed from the cavity of the small intestines by the radiated extremities of the lacteals; is propelled through the lacteals by their muscular coats for some little way; after which it is again deposited, by another set of radiated extremities, into the cavities of the glands; from whence it is again absorbed by the radiated extremities of other lacteals; and thus alternately, till, having been strained through a vast number of small tubes and cells, it is at last thrown into the thoracic duct, and by it is propelled into, and mixed with, the blood in the veins.

In the second place, the lymph is the fluid supposed, by the first discoverers of the lymphatics, to be found only in them, and not in the lacteals, and which occasioned their forming these vessels into two classes. The truth is, the lacteals transmit chyle, when there is any chyle in the intestines; and at all other times either transmit lymph, &c. or are empty, and do not transmit any fluid.—The lymphatics commonly carry the lymph into the blood; but some of them may occasionally also convey the chyle, as I have demonstrated in the lymphatics of the diaphragm. Neither the lymph, then, nor the chyle are uniform fluids, but liable to considerable variation, and absorbed only at particular times.

Haller, the most accurate of anatomists, says, "Et primum chylus per vasa lactea movetur, et celeritur quidem. Nam vulgare est, jam alias citatum, spectaculam, chyli in vivi animalis lacteis vasis conspicui, qui paulo post evanescit omnis, ut vel lympha succedat, vel inania vasa nuda supersint. Vidi etiam cæruleo colore tincta vasa lactea perinde evanuisse. Et vicissim, cúm in cisterna lympha esset, lac in ejus locum successit et in ductum thoracicum." And afterwards, to the same purpose, he adds, "In ductu thoracico eadem phenomena vidi, et evanescentis chyli, et lymphæ, quæ post album chylum secuta est, aut alioquin inanem ductum replevit."

In the purest state that I could procure the lymph, I found it possessed of the following properties. It resembled water in fluidity, was transparent, sometimes of a straw-colour, or even brown; it also either coagulated wholly, on extravasation, or coagulated in part, as the animal from which it was taken was either stronger or weaker. The same thing happened in the dead body, where it coagulated from rest, or in consequence of death. Mr. Hewson says, that he has seen it coagulate round the edges of a wound received in the integuments, across the middle of the tibia, in the human subject, where the cutaneous lymphatics situated there were accidentally divided, and which of course could not prevent their lymph from escaping at the wound. Haller mentions similar wounds of the lymphatics from bleeding in the arm, where the flow of lymph was excessive, and could not be stopped but by the use of a great quantity of vitriol—" plurimo vitriolo imposito." But he does not say that it coagulated on the surface of the skin.

Diemerbroeck says, in consequence of experiments made on the lymph in living animals, " Lympham ex vasis lymphaticis prope hepar aliisve, in cochleari collectam, ab aere frigido in gelationem concrevisse, et modo subflavum, modo alium colorem conquisivisse, non semel observavimus." —In the lymph I obtained from quadrupeds I never could perceive any taste or smell, nor any symptoms of putrefaction, after I had kept some of it for twenty-four hours in the month of June. The lymph is now commonly supposed to be the fluid absorbed from cavities and surfaces. Before we can shew the importance of its being absorbed, I think it necessary to say something of the structure of these cavities and surfaces.

Anatomists use the term *cavity* in a different acceptation from other people. They speak of the cavity of the scull, cavity of the thorax, and cavity of the abdomen, as if they contained air, or a considerable quantity of fluids. The truth is, they are compleatly full, by their surfaces being applied to each other, both in the living and even in the dead body. The term *internal surfaces* would have been better than cavities.—But, having said so much by way of explanation, without altering the usual language of anatomists, we shall give some general idea of these cavities.—Without including the cavities in the vascular system, the cavities in the body may be divided into those which contain the viscera, into the cavities of the usually termed hollow viscera themselves, the cavities of joints, the cells of glands, and the cells of the cellular membrane.

There are some other cells, but I consider them as appendages of the vascular system; nor would I wish here to be understood as including the cells of bone. In the cavities containing the viscera, particularly those of the thorax, and abdomen, the surfaces of the cavities themselves, as well as of the contained viscera, are large, and allow of a considerable extent of motion between each other. These have no communication with the surface of the body; and are every where imperforated, except by the mouths of the exhalent and absorbent vessels. The cavities of the hollow viscera, on the contrary, open upon the surface of the body: as the stomach and intestines, urinary bladder, and the uterus and vagina in women. Their surfaces also are constantly moving upon one another. The cavities of the joints have a greater quantity of friction and motion between their surfaces than either of the former. There is no great friction or motion in the cells of glands, but there is certainly some; and the cellular membrane, composed in some parts of the body of exceeding broad laminæ, and in others of exceeding small, admits of a great variety of friction and motion. These surfaces are all moist; and though we have said that, strictly speaking, the term cavity should not have been employed: yet so far anatomists may be justified, that, although the surfaces of these cavities are generally applied to each other, they are all capable of being dilated, and of occasionally containing more. The arteries, or perhaps certain other vessels arising from them, and known commonly by the name of exhalents, are constantly throwing out a fluid into all the cavities of the body; this fluid keeps the surfaces moist, and makes motion easy, by allowing them to slide readily upon one another. This fluid, however, would accumulate in such quantity, as to produce dropsy of all those cavities, if the lymphatics were not constantly absorbing it: now, though this alone is a very important function, nay, absolutely necessary to the continuance of the animal machine, I suspect that the lymph is a fluid more extensively useful, and that this is not all that is meant by making the lymphatics take it up. I suspect that the fluid found in the lymphatics is, in part, the coagulable lymph of the blood; the fluid on surfaces never appeared to me to have that property which the lymph has, of coagulating from extravasation, or from rest in the dead body. Mr. Hewson's experiments, by which he believed that he had proved, that the fluid on surfaces, and the fluid in the lymphatic vessels, were the same, never succeeded with me. He used to scrape, with a wet spoon, the surface of the peritonæum or pleura, till he had collected some considerable quantity of fluid: on letting it stand, he found that soon after it coagulated; and he considered this as a strong proof of the lymphatics absorbing from surfaces, as the chyle's being white and coagulating in the intestines, and being of the same colour, and having that property, in the lacteals, was a proof of their absorbing it from the intestines,

testines. This experiment is liable to deception. In scraping these surfaces, vessels, containing a coagulating fluid, may be torn, and it may not be the fluid of surfaces which is thus collected: besides, the liquor of the pericardium, and of the ventricles of the brain, and of the tunica vaginalis testis, which are analagous fluids, never coagulated, in any of my experiments, under a less heat than that of 140 or 160 of Farenheit's thermometer; besides, the quantity of lymph in the lymphatic vessels is greater than we could suppose it to be, were it only the fluid of surfaces. Whether, therefore, they absorb it from the cavities of the blood-vessels, as they do fluids from surfaces in common, or whether they arise also from the extremities of arteries, as Bartholin asserted, I do not know: I am rather disposed to think the lymphatic vasa vasorum may take the coagulable lymph from the cavities of the blood-vessels, for some purpose yet unknown.

I am also disposed to think, that the vis a tergo, in the primary lacteals and lymphatics, propel the fluids deposited in the cells of the glands, through their cells; for the extremities of the vasa efferentia are connected only with those ends of the glands which are opposite to the inferentia; and the succeeding fluids must either come in contact with the absorbing orifices of the vasa efferentia, in consequence of the vacua they form by removing the fluids in contact with those orifices, or some vis a tergo must propel them. One of the most eminent physiologists in London * is disposed to think that the vis a tergo is lost, by throwing the absorbed fluids into the cells of the glands; and that, in order that the vis a tergo should have any effect in propelling the fluids through these cells, it is necessary they should be tense, which he believes is not the case: it may, however, be otherwise. If it is not so, there is apparently a great loss of power; and the absorbents from the cells of glands are obliged to begin to absorb from the cells, in the same manner that the primary absorbents did from surfaces, without any advantage from the vis a tergo in the fluids of the vasa inferentia. But absorption from cells in glands may be as easy as from the first surfaces, and nature may be able to dispense with this apparent loss of power: or it may be as Bartholin suspected, the

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* Dr. Fordyce.

lymphatics may also arise from the extremities of arteries; and the power lost by throwing the absorbed fluids into the cells of glands may be compensated by some impulse given to the chyle and lymph, in the lacteals and lymphatics, from the fluid of arteries, though I suspect it is not so. Though in the former edition of this work, I have said, that I did not know the use of the lymphatic glands, I think it probable that they divide the work of absorption amongst a great number of different vessels: the vas inferens, for example, takes up chyle from the cavity of the intestines, and propels it into the nearest lymphatic gland; this becomes a temporary reservoir, and may be considered as entirely passive; the vas efferens absorbs the chyle from the cells of the gland, and, as larger in size, propels it with additional force towards the next gland; and thus in succession, till it comes to the thoracic duct. That the glands also produce some change in the chyle and lymph, is extremely probable, perhaps gives them a greater disposition to be converted into blood; but I am not certain that this is their function. That these glands serve to mix animal spirits with the chyle, by means of the nerves, is an idle supposition, since we have no proof of any such spirits; and the nerves entering these glands are scarce demonstrable, as we have said: that they serve to form the central particles of the globules of blood, as Mr. Hewson and Falconar contended, is as improbable, since these central particles have not been seen by the first microscopic observers in the world; I never have seen them; Haller says he once saw it, but supposes it a morbid appearance.

The diluting the chyle and lymph, by mixing some secretion of the arteries in the glands with it, is also another idle supposition, supported by not even the shadow of a proof, since it supposes the chyle too thick, which has never been proved, and since the fluid of the glands, to every microscopic observation, is not more dilute than the chyle or lymph themselves.

Besides the fluid which moistens the cavities of the hollow viscera in common with all other cavities, there are great quantities of other fluids poured into them: the drink taken into the stomach may be two pounds in twenty-four hours; the saliva swallowed may be one pound in the same period, the gastric juice another, the pancreatic juice another. The bile poured into the intestines Haller supposes about twenty ounces, besides the fluid secreted through the whole of the internal surfaces of the intestines. The urine bears some proportion to our drink; but the fæces are in a small proportion to our food, the chyle, and to these fluids. Boerhaave supposes that all the secreted fluids, except those of the kidnies and skin, are returned to the blood by the absorbents. A very great part, I believe, is returned, but changed into lymph. Dr. Fordyce believes that a living body has a power of destroying animal and vegetable matter, and converting it into water, in a manner not yet understood. Perspiration may then carry it off.—But the proper discussion of this subject would require a volume of itself.

In the third place, there cannot be a doubt but that the lymphatics absorb on the surface of the body, and on an analogous surface, the internal surface of the trachea, and air-cells of the lungs. Erasistratus taught that the arteries absorbed air: and Galen says that the veins absorb, ȣκ ολιγαν μοιραν περιεχομενος ημας αερος. And says, that this was what Hippocrates alluded to in part, when he said, "Εκπνοον και εισπνοον ολον το σμωα."—Dr. Hales found, in distilling blood, that a thirty-third part of the whole was air. Haller, alluding to those experiments, says, "Utique fere trigesima tertia pars totius sanguinis verus est aer."—Whatever happens from distillation of blood out of the body, I am perfectly certain, that there are no loose masses of air in the blood. I have tied up the trunks both of arteries and veins, when they were turgid with blood, in the living animal; on opening them under water, not a particle of air shewed itself. I even tied up the cava superior, and the inferior, as far as the diaphragm; and, removing them with the heart and lungs entire, under which circumstances, from the lungs being collapsed, they remained turgid and unchanged, as well as the right auricle and ventricle, I placed them in the receiver of an air-pump, and exhausted it; but neither these veins, nor the right auricle and ventricle, did swell, nor shew any symptoms of containing air.—The Chevalier Roza, in Italy, has endeavoured to confirm the opinion of Erasistratus by experiments, by tying up the trunks of arteries when they appeared to be turgid with blood. On opening these arteries, an elastic vapour, he says, escaped, and they contained but very little real blood. Harvey, in his experiments, found nothing but blood in arteries.

teries. I have seen nothing like this vapour. Haller, speaking of the air of the blood, says, " Ita in reliquo humore dissolutus, ut nulla ejus bulla adpareat." And experiments made on the blood, in the air-pump, by others, rather confirm mine. " Valde spumat in spatio inani urina et succus amnii; in albumine multus est aer; ex sanguine difficulter prodit Musschenbroeckio teste."

As to Galen's and Hippocrates's doctrine, that the veins absorb air from the atmosphere, I have proved that they do not absorb any thing.

That something from air enters the blood-vessels of the lungs, and combines with the blood, is probable, from the change of colour it puts on as it passes through the lungs during respiration. How this is effected, I do not know. It is also probable, that the lymphatics of the skin take in something from the atmosphere. Professor Home found himself heavier in the morning than he was just before he went to bed in the preceding evening, though he had been perspiring all night, and had received nothing, either by the mouth, or in any other sensible way. The Abbé Fontana also informed me, that walking some hours in the open and damp air, immediately after the operation of a purgative, that on returning home, and weighing himself again, he was some ounces heavier; a circumstance which cannot so easily otherwise be accounted for, than by supposing an inhalation from the atmosphere. The celebrated De Haen, finding that his dropsical patients filled equally fast, whether they were permitted to drink liquids or not, did not hesitate to assert, that they *must* absorb from the atmosphere. That the surface of the skin absorbs other fluids, which come in contact with it, I have not the least doubt. A patient of mine, with a stricture in the œsophagus, received nothing, either solid or liquid, into the stomach, for two months; he was exceedingly thirsty, and complained of making no water. I ordered him the warm bath, for an hour, evening and morning, for a month, his thirst vanished, and he made water in the same manner as when he used to drink by the mouth, and when the fluid descended readily into the stomach.

In the fourth place, these fluids are not only absorbed by these vessels, but we have the strongest reasons for believing that the solid parts of the body are also, on a variety of occasions, removed by them; an opinion, I believe, first advanced by Mr. Hunter. That the solids are removed, appears from the following facts. In young animals, the cavities of the cylindric bones enlarge as the bone enlarges, so that that cavity which was at first not so large as the cavity of a crow-quill, will afterwards receive one's finger, particularly in quadrupeds, bearing always the same proportion to the bulk of the bone; but this could not take place unless there was a power taking from the inside in proportion to the addition that was made on the outside. The same thing must take place in the cavity of the skull, which enlarges as the brain enlarges. It is not only in growing bodies that we observe this removal of the solids; we perceive it again in old age: there is then not only a general shrinking and wasting of the whole body, but, in particular, the alveolar processes are removed; the nose, for this reason, comes nearer the chin; there is a redundancy of the lips, and the tongue, in consequence of the cavity of the mouth having been so much diminished, and the speech, for these reasons, becomes indistinct. There are also other instances of the removal of solids in old people, that come less under common observation. The bones have then lost one fourth of their former weight, at least; a great part, therefore, of their substance must have been removed. That solids formed from disease are frequently removed, every body must have observed. A venereal node, for example, forms on the tibia, swells to a considerable size, and afterwards, from the use of mercury, disappears entirely. A testicle or a breast enlarges to double or quadruple the natural size, continues in this state for years, and afterwards returns to the natural size. Ulceration takes place on the breast of a woman, and spreading destroys it entirely, and in this way almost any part may be removed. The solids, then, are either constantly changing, or occasionally removed. Now if the lymphatics and lacteals remove fluids, it is extremely probable that they remove the solids also, and that they not only bring in nutritious matter into the body, but have an equal share with the arteries in the disposing of it at last, and by that means co-operate with the arteries in giving shape to the solids in growing bodies. They also in a manner take down the body in old age. They are the principal agents both in the cure and removal of diseased solids. How those vessels remove solids is difficult to say. It is not easy to account for their mode of absorbing fluids: I suppose this last performed in the following way:—The liquid to be absorbed affects the mouth of the absorbent, and determines it to give it admission or not. If it gives it admission, the first part of the lymphatic absorbs it, perhaps, as has been supposed, by its action, as a capillary tube, or from a living power. This fluid having entered, and filled the first part of the absorbent, now stimulates its internal cavity, which again contracting, propels the fluid towards the trunks of the system, as the valves do not permit it to relapse into the cavity from whence it was absorbed. Having propelled the fluid it last absorbed, the mouth of the vessel relaxes again, becomes empty, and a fresh quantity is taken in, as long as any fluid presents itself. It is not certain that absorption of fluids does not begin, in the extremities of vessels, on the principle of capillary attraction only: this was the opinion of Aggiunti. But there is something in the action of the absorbing orifices which resembles selection; nor is the absorption so constant or uniform as capillary attraction must necessarily be. If the end of an empty capillary tube is immersed in a fluid, the fluid must rise in it, if it meets with no obstruction; but the extremities of the lacteals are often immersed in chyle without taking up any of it, as I saw in the orifices of the lacteals on the intestines; for some of the villi we loaded with chyle, whilst others almost in contact with them were entirely empty. Boerhaave says, that the absorbed fluids rush into the lacteals and lymphatics; because the thoracic duct, contracting on its contents, is constantly forming vacuums; and that the velocity with which air rushes into the exhausted receiver of an air-pump, is twice that of the swiftest wind, or forty-four feet in a second, as he had proved. This I doubt, for no vacuum can be formed by emptiness in any part of the body, because the pressure of the atmosphere would always force the surfaces together, unless perfectly defended by bone.—If the absorption of fluids is difficult to be explained, much more so is the absorption of solids. Mr. Hunter supposes that the absorbents take down solids by a kind of reverse action to that of the arteries in forming them. He does not pretend to know how this is actually performed; but says, it is not more difficult to conceive absorbents removing bone, than to conceive that the arteries form it, which they certainly do. He supposes they may have a power similar to that of a caterpillar eating up the leaf of a tree; and believes that the absorbents elongate themselves, or shorten themselves, as their object recedes or approaches nearer. He even believes that the absorbing vessels of surrounding living parts are capable of elongating themselves, and of absorbing dead bone, which we see sometimes partially and sometimes wholly removed. We know that the lymphatics certainly take up solid particles; there can hardly be a doubt of their absorbing the powder of calomel from the surface of the body, and that they carry it into the blood-vessels. The globules of quicksilver, in the best prepared mercurial ointment, are never so small but that they may be distinctly seen in the microscope; and yet we know that they are absorbed.

It is possible that, previous to the absorption of a solid, the parts immediately to be absorbed may be broke down, mixed with, or even converted into fluids. It is the opinion of some, that there is one menstruum in the body, which is actually capable of converting a solid into a fluid, the gastric juice, and that it converts various solids into one constant and uniform fluid, the chyle. The arteries may secrete a fluid on the surfaces of bones, on particular occasions, capable of doing the same thing; or there may be also a fermentation, peculiar to the solids of a living body under certain circumstances, by which they may be decomposed and converted into fluids, retaining all the elementary particles of the solids. Mr. Hunter allows a decomposing principle in the substance of teeth; and, speaking of their decay, arising from rottenness, says, " This is owing to the enamel loosing its regular and chrystallised " texture, and being reduced to a state of powder, from the attraction of " cohesion being destroyed." Fermentation has been observed chiefly in dead matter, and is commonly accompanied with ebullition and extrication of air; but fermentation may also take place, and I believe certainly does take place in living matter. Ebullition, or any evident motion, is not necessary to constitute fermentation; after wine has undergone what is called its open fermentation, it continues, after it is bottled, to go through its secret fermentation, where no motion is evident, and, every body knows, requires time to ripen. All that is necessary in fermentation is, that the elementary particles be separated and recombined, so that the matter be converted into something different from what it was before. There are some facts which dispose me to believe that the first step in the removal of solids is not owing to the action of lymphatics or lacteals; I have observed, in internal exfoliations of cylindric bones, where a very large portion of the old bone had died throughout, that the cancelli were destroyed, and that the bone must have been thinned as much upon the inside as it was upon the outside; nearly the whole length of the tibia was in this way reduced to a tube whose sides were not thicker than a wafer, and resembled portions of cylindric bones which had been exposed for some time to the action of the gastric juice in the stomach of a leopard; some of which I have preserved in the state I found them. As almost the whole bone died at the same time, which was evident by the lines of separation at the two extremities, without any intermediate similar lines, and which we constantly find on such occasions, whatever change after took place in its centre and inner surface, could not be owing to the action of vessels; they died at the same time the bone died. It may be objected, that it is impossible to discover what has happened in a diseased bone, but by sawing it open, maceration in water, drying, &c. and we can never be certain what was the effect of these operations, and what actually took place while it remained in the living body. This is not true. There are opportunities of seeing what has happened to diseased bones, without any of these processes. I have seen appearance, similar to what I have here described, taking place in the living body after the operation of the trepan, or in other cases where a whole parietal bone had been killed, and left to separate by the powers of the body.

I have frequently observed, that the shedding teeth of horses wasted for an inch or two in length, after their connection with their own vessels were broken off, and that this wasting had taken place though the teeth must have been all the while lying on the upper surfaces of the succeeding teeth, which we know are not at that place vascular. In the process of exfoliation, when the living bone separates from the dead, it is the living bone which is removed, at the place where it is in contact with the dead bone; no alteration whatever takes place in the dead bone, but it drops off as it were in consequence of the living bone's retiring from it: but this fermentation, by which a solid is converted into a fluid, may, in a greater degree, depend upon the living principle, and may therefore take place more readily in the living than it does in the dead bone; which is just the reverse of the fermentation that takes place to destroy dead animal matter in general. Dead animal matter, and dead vegetable matter, in general, go quickly into this fermentation; dead bone requires a long period before it is decomposed, but is at last converted into a powder. The oil in the cells of dead bones appears to undergo a fermentation, by which it is converted into a white powder, which shews no other symptoms of its having been originally oil, than that some part of it still liquefies when placed on a red-hot iron. But in whatever way the lymphatics and lacteals remove solids, it is, in the point of view we are now considering it, of the utmost importance to the constitution. The solids of the human body are not ductile, as has been imagined; nor malleable, as some metals; and they acquire their shape from the arteries depositing matter on one side, and the absorbents taking it from the other. It is also of the utmost consequence to the animal machine, that the living solids should be removed from the dead, as in the process of sloughing, by which the softer living solids are removed from the dead, and in the process of exfoliation, by which the parts of living bone are also separated from the dead. There is another absorption of these solids, but as it is a morbid process, it will be considered by itself presently.

In the fifth place, the lacteals and the lymphatics introduce medicines into the blood-vessels, and by this means prevent as well as cure diseases. —There are some medicines which appear to produce their effect by acting on the nerves of the skin or stomach before they could be absorbed or carried into the blood-vessels. Opium, for example, sometimes almost instantly relieves pain, and wine and volatile alkali as quickly sometimes take off debility. The Peruvian bark has been vomited up in solid masses after it had cured the intermittent for which it was exhibited. There are other medicines which produce their effect by sympathy, in a manner hitherto inexplicable, and some applications produce their effect by counter-irritation. Thus, a blister applied to the head, or between the shoulders, on the first attack of a fever, has presently carried it off. But in order to prevent or to cure diseases, it is often absolutely necessary that the remedies be introduced into the blood-vessels. Mercury lying upon the surface of the skin, or passing over the surfaces of the stomach and intestines, without being absorbed, would never cure the venereal disease; nor do the venereal symptoms, in general, give way, till those of mercury being in the constitution shew themselves. It has even been asserted, that the mercury has afterwards been found in the cells of bones themselves: Mead says so, on the authority of Brassavalus, and Boyle, &c. I never saw this. Rhubarb not only affects the internal surface of the intestines, and purges, but is also absorbed by the lacteals, carried into the blood-vessels, and, passing off with the urine in the kidneys, imparts to it the yellow colour which every body must have observed in that fluid, after taking rhubarb. It was in consequence of this observation that Haller exhibited rhubarb in small doses in the diabetes, expecting from its astringency, that it would contract the arteries of the kidneys, which he supposed either to be too much relaxed, or uncommonly dilated. Many medicines appear to be absorbed and carried into the blood-vessels without being altered as to their original properties: thus purging medicines, or even mercurial preparations, exhibited to nurses, appear to have been absorbed, carried into the blood-vessels, and secreted with the milk by the arteries in the breast, and in this way have sometimes produced similar effects upon the children which they have suckled, as they did on themselves. The colouring particles of madder, not only affect some of the secretions, but impart a red colour to the growing bones of young animals; and turpentine, given by the mouth, some time after may be discovered by the smell in the urine. We cannot so well, on any other principle than that of absorption and after deposition, account for the inflammation which takes place in the neck of the bladder, and produces a suppression of urine, when the tincture of cantharides has been exhibited by the mouth. The cantharides remaining unaltered in the absorbents or blood-vessels, and being afterwards secreted by the arteries of the kidnies, and carried with the urine to the bladder, solves the phenomenon, as it produces a degree of the same effects there which it produces on the skin.

In the last place, the lacteals and lymphatics become the causes of the most fatal diseases which attack the human body: this also puts these vessels in a very important point of view. These diseases may be divided into the following classes: In the first place, such as arise from these vessels not absorbing the healthy and sound fluids and solids of the body; secondly, such as arise from their absorbing too much of the healthy and apparently sound fluids and solids of the body; thirdly, such as arise from absorbing morbid fluids generated in the body; fourthly, such as arise from absorbing the diseased solids of the body; fifthly, such as arise from their absorbing irritating substances not generated in the human body, the infectious matter of diseases from other persons, and poisons, animal, vegetable, and mineral, from whatever quarter.

In the first place, it is possible that the lacteals may not always absorb the chyle after it is formed, and the patient may be cut off from that cause. —I have already given my opinion respecting Ruysch's doctrine, that in old age he lived without his lacteals, and that old people in general did so. I think it impossible; but Morgagni and Dr. Hunter himself inclined to that side, at least so far as respects the obliteration of the glands of the mesentery. The lacteals are never obliterated: there are no other roads by which chyle can get into the blood, as Haller allows there may possibly be; and the red veins of the intestines do not absorb.

It is possible that children, and even grown persons, may sometimes have died of the tabes mesenterica, a disease in which the glands of the mesentery belonging to the lacteals are supposed to be totally obstructed and impervious to the chyle. In such enlargements of the glands, if they ever take place, we should meet with the stagnation of the chyle in the first set of lacteals; but I never saw such stagnation on any occasion whatever: but as stagnation of the lymph, from obstructed lymphatic glands of other parts, is said to have been seen, it may be possible that the chyle, from the causes mentioned, may have sometimes been prevented from getting into the blood-vessels.

The lymphatics sometimes have their orifices immersed in fluids, without taking up any sensible part of them; possibly the lacteals may sometimes be in a similar situation.

When the lymph is not absorbed from cavities, or not in the usual proportion to the quantity secreted by arteries, dropsy of these cavities must be the inevitable consequence, as there is no transudation in living bodies, nor any other openings than the mouths of the lymphatics and the exhalent orifices of the arteries, which cannot absorb.—Dropsies appear to me to be of three kinds. The first is, where there is a general debility in the body: this is felt most in the lower extremities or legs; the extremities of the arteries are so relaxed, that they permit the thinner fluids to escape into the cavities of the cellular membrane, whilst the lymphatic vessels, having lost their tone, do not take up these fluids. Cases of this kind are frequently met with in young people from temporary debility, who have undergone some tedious and dangerous disease; as after fever. From this they frequently recover; but it is a very bad symptom in old age, accompanied with asthma, as it is most probable that the visible dropsy of the legs is then accompanied with an invisible one, or water in the chest. Women frequently bear this swelling of the legs longer than men, even for years, without any danger. Some men have sustained it for twelve years, without the least decrease of their general health. I have seen the integuments of the ankles hanging over the shoes for months, and yet the patient has perfectly recovered.

The second species of dropsy is very common, and is that which arises in consequence of previous inflammation of a cavity; and may take place in any habit of body. If an inflammation arise in a cavity, it may terminate in a number of different ways: one of these ways is by an increased secretion of the fluid of surfaces.

A man receives a blow on the testicle; inflammation takes place, and the consequence is frequently a hydrocele, or dropsy of the tunica vaginalis. A child's brain inflames, and this inflammation ends at last in hydrocephalus, or collection of water in the brain. Pleurisy frequently terminates in hydrothorax, or collection of water in the chest. I have often taken away forty or sixty pints of water, which had accumulated in the cavity of the abdomen, in the few days the peritoneal inflammation had lasted, during the usual species of the child-bed fever. This is to be considered as the substituting a less dangerous disease for another. Peritoneal inflammation kills often in three days, but ascites may last twenty years.

When the arteries of the part have once got a habit of increasing their secretions, they commonly go on for a long time. The lymphatics may, in some cases, absorb their usual quantity of the fluid of surfaces; but, as the fluid secreted by the arteries often far exceeds the quantity which they absorb, the dropsy is still kept up; or, the lymphatics may be so altered by the inflammation, as not to absorb a sufficient quantity.

The third species of dropsy is that which arises from some obstruction to the return of the venous blood to the heart. This may happen from the blood of the vena portarum being obstructed in its course to the heart by a schirrous liver; ascites, or dropsy of the abdomen, may be the consequence. It may happen from inflammatory adhesions of the substance of the lungs retarding the passage of the blood of the pulmonary artery through that viscus. In either case, the venous blood is obstructed in its passage to the heart; the arteries find a greater resistance to their throwing their blood into the veins, and are obliged to relieve themselves by an increased secretion from their exhalents, and thus most probably dropsy is produced in the cavities to which they belong; for when the obstruction is removed, the dropsy disappears. — In a case which I attended some years ago, the patient had dropsical swellings of his legs, at the same time had a hoarseness which had lasted for two years. One morning, in stooping to buckle his shoes, he burst a blood-vessel in his lungs, and from this accident lost about two pounds of blood; both the hoarseness and the swelling of the legs gradually went off, and he continued well for two years after.

A boy, nine years of age, had for some months dropsical swellings of the lower extremities; at first the pulse was strong and frequent, and the heart gave the aneurismal stroke: I said there was some great disease in the chest. After his death, I was permitted to open the body; the right ventricle of the heart was twice as large, and twice as thick, as the left ventricle; just the reverse of what is natural. The reason of this, I found, was a laminated coagulum of blood, about the size of a small cherry, attached by a peduncle to the beginning of the pulmonary artery, and nearly blocking up its cavity.

A married gentleman, about 35, became suddenly melancholy, complained amongst other things of being lately gradually unman'd, his legs began to swell, his urine became scanty and turbid, and he could not go up stairs without losing his breath. I suspected water in the chest; in three months he died. I opened the body, there was water in the chest, but there was an abscess in the right auricle of the heart, containing about an ounce of pus, and surrounded with coagulated laminated blood to a considerable thickness.

Dropsies may destroy in a number of different ways.—The terror of the mind may combine with the debility of the body, in the first species of dropsy, and the patient may be quickly cut off from this cause. In œdema of the limbs, the cuticle frequently ruptures at last, and inflammation of the cutis underneath is commonly the consequence. Whether inflammation takes place from this cause, or whether it takes place in consequence of scarifications, either mortification takes place, which is commonly fatal, sometimes even in three days, or the inflammation, without any mortification, is in this habit of body accompanied with such irritation as to destroy. The hydrocephalus kills by the too great pressure it makes on the substance of the brain. The hydrothorax kills by compressing the substance of the lungs in such a manner as to prevent respiration at last. If the ascites does not kill by increasing the general debility of the body, preventing sleep, digestion of the food, and exercise, and in a great measure impeding the action of the lungs; the operation which is performed to relieve the patient, kills at last, by producing peritoneal inflammation.—The chief circumstance in the diseases we have mentioned is, that the lymphatics do not take up the morbidly accumulated fluid: that this frequently arises from some defect in the action of those vessels. We collect from this circumstance, that medicines now and then stimulate them to absorption, and the morbidly accumulated fluids are removed. At other times, though no medicine whatever has been exhibited, the whole water of an ascites has been removed in three days, from some stimulus in the constitution itself, given to those vessels.

It sometimes happens that the cancelli and cavities of bones are obliterated or filled up; the bone, of course, contains more solid matter, and is heavier than natural. I suppose this to be owing to the lymphatics not counteracting sufficiently the arteries, in removing the earth, in their usual proportion to its being deposited by the arteries. Most frequently, however, this is the effect of inflammation of bones.

In the second place, diseases may arise from the lacteals and lymphatics taking up too much of the healthy and apparently sound solids and fluids of the body.—The absorbents are always taking up the thinner part of the bile; but on particular occasions, such as a gall-stone sticking in the common duct, and preventing the flow of bile into the intestine, the gall-bladder and the pori biliarii become uncommonly distended with the bile, and the lymphatics, to relieve this distension, absorb the bile from their cavities, carry it into the blood-vessels, and produce jaundice.

After a woman has lain-in some days, she is sometimes taken with shivering, and other symptoms of fever; her milk disappears, the fever goes on, and she dies. On opening the body, the cavity of the abdomen has on such occasions been found full of a whey-coloured fluid mixed with laminæ of coagulated white matter. The fever, by many, has in this case been attributed to the absorption of the milk from the breast, and its being carried into the blood-vessels; believing the appearances they saw in the abdomen to be from the milk, they have given it the name of dépôt du lait. I do not contend that the milk, in this case, is not absorbed; but I believe that milk would do no mischief in the blood-vessels. The appearances in the abdomen are peculiar to the peritoneal inflammation, and would have taken place if the patient had been a male instead of a female. The whey-coloured fluid is the fluid of surfaces increased in quantity, and mixed with pus; and the curdled matter is the coagulable lymph very constantly found on inflamed surfaces. I have seen the same appearances in virgins, who have died in consequence of the general irritation of fever becoming local, and by metastasis transferred to the abdomen. I have seen the same appearances in the dead bodies of men from the same cauſe. After labour, the cavity of the abdomen is in part debilitated, from the great change it has undergone in passing from a state of great tension to a state of great flaccidity; and if the woman catches cold, or receives infection, the mischief falls on the abdomen, as the weaker part; just as a person liable to rheumatism or gout, or catarrh or diarrhea, on catching cold, is seized with these different complaints.

There is another fluid, which the lymphatics also, on particular occasions, take up, and carry into the blood: I mean the urine. I am perfectly confident of this, from attending to what has happened to myself on a great variety of occasions. I have had the strongest calls to make water, and felt that the bladder was full; but, not having it in my power to quit the company, the symptoms in some little time after have gone off. In an hour or two after, on attempting to make water, I found that the bladder contained little or none. I have not a doubt of the urine being absorbed, and carried into the blood-vessels. How often the lymphatics may remove the urine from the bladder, or why they do not always absorb it in suppressions of urine, I do not know: an uncommon distension of the bladder may compress the orifices of the lymphatics, and make absorption then impossible. It is for this reason that our urine in the morning is brown, reddish, or high coloured, while that made soon after drinking is limpid. During the night the thinner parts of the urine have been absorbed, and a concentrated solution of neutral salts, and putrescent mucilage, have been left behind.

The softness of the bones in the mollites ossium, I believe, is owing chiefly to the lymphatics taking up the earth in too great quantity from the bones. We have seen large portions of bone removed, which were in themselves perfectly sound, in consequence of the pressure of some tumor on their surfaces; great part of the bones of the scull itself have in this way been removed.

In the third place, diseases arise from the lacteals and lymphatics taking up morbid fluids generated in the body.—It is the opinion of one of the first physiologists, Mr. Hunter, that when variolous matter is inserted into a wound, in the inoculation of the small-pox, all that it does, is to stimulate the surrounding parts to secrete a fluid similar to itself, which being absorbed, infects the constitution; and that the patient really receives the disease from variolous matter generated in his own body. The swelling of the glands of the axilla, which are symptoms of absorption of the matter, certainly do not take place till the pustule is fairly formed in the inoculated part; nor do the symptoms peculiar to the small-pox take place till after that period. It is possible that the venereal poison, and the poison of the mad dog, may be absorbed in the same way; for they generally remain long in the part to which they were originally applied, and matter is commonly formed on that surface before the symptoms peculiar to these diseases take place. There is one poison which is certainly generated in the body, but which must be absorbed before it can infect the constitution: I mean the poison of cancerous matter. There is another fluid, the absorption of which has been said to produce very fatal effects in the constitution: I mean pus. Hectic fever and pulmonary consumption have happened after large suppurations; but whether these are to be attributed to the pus being absorbed, and carried into the blood vessels, or whether they are not rather to be ascribed to the debility induced in consequence of the irritation of long-continued sores, may be doubted. The quick pulse, in hectic fever, appears frequently to be a symptom only of irritation: accordingly, the pulse has become slow and natural, when a limb, with the sore which kept up this irritation, has been amputated. I foresee that it may here be objected, that the source of absorption of pus being removed with the limb, the irritation must subside with the cause; but I have seen cases where it subsided so soon after the amputation, that I was satisfied it was the pain, and irritation of the sore, and not the absorbed matter, that was the cause of the hectic fever; * hectic fever has also been found to take place where there was no pus to be absorbed. If hectic fever always followed the formation of pus, absorption of this fluid might with more propriety be suspected as the cause; but very large abscesses have been formed without it. It is possible, however, that pus may sometimes be absorbed, and produce hectic fever. In cases of large abscesses in the body, brownish or dun blotches are sometimes found on the skin, both on the trunk of the body, and the extremities, along with hectic fever.

In the fourth place, the lacteals and the lymphatics increase, if they do not produce entirely, some diseases of the solids.—The lungs are affected with scrophulous inflammation: whether the lymphatics are the cause of this, I do not know; Dr. Hunter believed, from the universal swelling of the glands immediately under the skin, in scrophulous patients, that the lymphatics took up some noxious particles from the atmosphere. Perhaps as the mucus glands of the eyes, nose, mouth, and lungs, are often first af-

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* In a very recent example, the hectic fever entirely disappeared in less than three days after the amputation (which was that of the flap), was performed; the pulse in that period, falling from a hundred and thirty to ninety; the patient sleeping well, and the appetite craving; but the absorption of pus must have been of five years standing, and its effects, if it has any, should not have gone off so soon.

fected in scrophula, these may be the cause of the affection of the lymphatic glands. But whether the lymphatics are the cause of the inflammation or not, they increase the disease, and render it more quickly fatal: they ultimately are concerned in the erosion of the blood-vessels of this viscus, and fatal hæmorrhages frequently ensue: the substance of the lungs is gradually removed, and the advantage of breathing atmospheric air is diminished in proportion to this loss of substance; the debility increases, and the patient dies. I have known even the whole of the lungs of one side removed from this cause. In other parts of the body, part of the coats of arteries have also occasionally been removed, and fatal hæmorrhages have thence ensued: part of the coats of the intestines have been removed, and the fæces escaping into the cavity of the abdomen have produced peritoneal inflammation, and killed in a few days. A young lady died after two or three days illness; before this she had been in perfect health: I was called, but she was dead before I got to the house: from her history I was at a loss how to account for her death; but on opening the abdomen, a day or two after, I found the contents of the stomach in that cavity; that they had induced peritoneal inflammation, and killed. On examining the stomach, I found a hole in it large enough to admit the end of my finger; this hole had been formed by absorption of part of the substance of the stomach from scrophulous ulceration; but its edges had adhered by inflammation to the under surface of the small lobe of the liver; this inflammation was evidently raised, by the powers of the body, to prevent the accident which happened, and if no violent vomiting had taken place, and tore this adhesion at this particular time, she might have lived for years, notwithstanding the ulcer. I have known part of the substance of the brain itself removed; and there is hardly a solid in the body, which we have not seen, on some occasion or another, suffer this loss of substance.

In the fifth place, the lymphatics and lacteals take up irritating substances not generated in our own bodies; the infectious matter of disease from other persons; poisons, animal, vegetable, and mineral, from different quarters. —Boerhaave had an idea that the orifices of the lacteals would take up no fluid but what was perfectly globular and mild, and he considered this circumstance as a guard on the constitution, for the more certain preservation of the animal: but every day's experience proves the contrary of this. The lacteals and the lymphatics take up the most irritating and stimulating substances. I have already mentioned that they took up spirit of turpentine, solution of cantharides, and solution of corrosive sublimate. Arsenic itself may be absorbed; and practitioners are obliged to desist from its exhibition as a medicine, on account of the pain that, after a certain period, it always produces in the bones. Dr. M'Kenzie, who had long resided in Constantinople, told me that the plague was only to be caught by contact, and that the buboe was always found in that limb which had touched the infectious matter. From still later testimony of the physicians who practice at present in those countries where the plague is found, as transmitted to us by the excellent Howard, it seems probable that contact is the principal mode of infection. * From the same authority, it is evident that buboes in the groin and arm-pits, are often the first symptoms of infection. The resemblance here to the usual mode of infection by the lues venerea, is very strong, and gives room to suspect that they are both introduced into the body by the lymphatics. Mr. Howard's own opinion is, that the plague is not generally received by contact, (by which I suppose he means the poisons being applied to the skin in a fluid form) but by inoculation, and breathing the putrid effluvia. Inoculation is more than contact, as we generally understand it; it is the insertion of infectious matter by a wound: and breathing the infected air, may be an application of infectious particles to the orifices of the lymphatics of the lungs. The infectious matter is, most probably, in most cases, taken into the body by the lymphatics of the skin; and it is at least probable, that it is taken into the blood, in the same manner, by the lymphatics of the lungs. That it commonly requires some days to produce the effects of the plague, is another argument in favour of it affecting the body through the medium of the lymphatics. That buboes are not always the first symptoms of the plague, is no more against what I am endeavouring to support, than that patients are often infected with the lues venerea, without a buboe

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* The Jew physician, at Smyrna, however, says, that it may be caught at the distance of some yards. The glands of the groin are also more frequently affected than those of the axilla; but as the hand is oftener the part of contact than the foot, these two circumstances may seem against me.

is a proof that they were infected in some other way than by the lymphatics; the contrary is now known to be true. The venereal disease, at first, was believed to be propagated by the breath of the infected person; and Cardinal Wolsey was indicted, among other things, for whispering in the king's ear, knowing he had this disease;—we now reject these absurd opinions. The mode of preventing the plague, as given us by Howard, also tends to confirm my opinion of its entering by the lymphatics,—"washing with soap and ley,—with soap and cold water, and wiping afterwards with a towel,—washing with a solution of quick lime in boiling water, &c." all tend this way. If we could wash the surface of the lungs with soap and ley, as well as the surface of the body, perhaps we might prevent the plague altogether; we can certainly prevent the venereal virus, in this way, from entering the body. Every body will perceive how very difficult it must be to come within a few paces of a person infected with the plague, without touching something which he has touched; so that infection, without contact, is liable to strong objections:—if touching a bit of wool, that the infected person has once touched, infects after months, how much more readily will the contact of what he has recently touched infect! even recent contact seems necessary, for, notwithstanding our intercourse with Turkey, the plague has not appeared here these 130 years. I strongly suspect that the same methods which prevent the venereal disease, will be found the most powerful in preventing the plague, that is, by avoiding contact; or, if that must be, by washing off infectious matter, and diluted caustic alkali does this better than any thing else; the dilution must just go beyond the preventing its action as a caustic, or inflaming the skin. I have also been told, that in the lazarettos they wash with soft soap, as containing more unsaturated alkali, and of course more readily combining with the mucus of the skin, to which the infectious matter adheres, and that thus they escape the infection. The not wearing woollen, but oiled linen, as easily washed as the surface of the skin, and the not permitting hair to grow on the body, would also tend very much to prevent infection. Washing with cold water alone, and wiping with a coarse cloth afterwards, has been known to prevent gonorrhea and shankers for years. Mr. Howard himself says, that after visiting the plague, he washed his mouth and hands in cold water, in order to prevent infection. Mr. Howard, however, speaks of some who caught the plague instantly, and felt the infection as if they had received a shock of electricity; he mentions others who had the same feeling without being infected—this looks like affection of the nervous system; he says also, that the first symptoms often is head-ach, but I have known the lymphatic vessels sometimes as suddenly affected; the prick of a needle in the point of the fore finger, has instantly produced red lines along the arm, and swelling in the glands of the axilla, and the head-ach does not prove that the poison did not enter by the lymphatics.

There are some poisons which kill instantly, but which must be always applied to a wound, or ulcer, to produce this effect: whether these are absorbed, or whether they act on the extremities of the nerves only, and through their medium on the whole nervous system, I do not know. Animals who die by the bite of the rattle-snake, live no longer than the period the absorbed poison may be supposed to have taken in reaching the heart. The matter of the inoculated small pox seems to lie in the pustle till the seventh day; after which, the glands in the axilla often swell, (the mark of absorption) and, by the time the matter may be supposed to reach the heart, the eruptive fever commences. Not only do the radiated extremities of the lacteals and the lymphatics take up the most stimulating substances, but their trunks, after those radiated extremities are destroyed, appear to absorb better than the original orifices. Venereal matter having produced an ulcer, is almost immediately absorbed; whereas, had the matter been applied to the original orifices, it might either not have been absorbed at all, or not till after a considerable period. This reasoning may be objected to, from the consideration that though the matter is applied, in ulcer, to broken extremities of certain lymphatics, it is at the same time still exposed to the radiated extremities of others which are entire. I do not know that this is not always the case. These vessels, then, *introduce* many diseases into the body from without, independant of their *producing* diseases within it of themselves. The infectious matter, however, may be frequently prevented from entering their orifices, by washing it off before it has had time to be absorbed, as I have said. The surfaces to which infectious matter has been applied, may be cut out, or may be destroyed by the actual or the potential cautery, even after the poison has begun to act on the surface, and the absorption may by this means be prevented. I have known a patient inoculated for the small pox, and on the fifth or sixth day, when it was evident the infection had taken, the infected spot was cut out, the patient had no eruption till some time after from a fresh inoculation. Even after the poison has entered the absorbent vessels, the remedy may sometimes be made to pass through the same vessels, and its natural effects on the constitution may thus be prevented: in the cure of the venereal disease, we rub mercurial ointment, the antidote, on the inside of the thigh, and parts of generation; because we know that, in entering the blood, it must pass through the same glands of the groin, through which the poison passed.

Sometimes the presence of one infectious matter will prevent, for a time, the agency of another one in the cellular membrane: a very curious instance of this I met with ten years ago. Elizabeth Inwood, two years and a half old, I inoculated for the small pox; the mother was poor, and lived out of town; I was asked in passing: I said I would call that day week; I was prevented, and on the ninth day found her very ill, but the punctures I had made in the arm were invisible; I, of course, after this, called every day to enquire into the cause of this strange appearance. She had inflamed eyes, sneezing, redness in the surface of the skin, and other symptoms of measles;—it was the measles.—These went through their usual course, and fourteen days after, when the constitution was getting free from this infection, the punctures I had formerly made in the arm began to inflame, and eight days after the small pox appeared. Sometimes these vessels take up poisons which produce universally incurable diseases, as we see in cancerous matter, when it has affected those parts which are out of the reach of surgery: sometimes, as I have said, they destroy a vital part, and the same vessels, which are of so much utility in preserving the body at one time, are also frequently instrumental in destroying it. There are no general laws, however excellent in themselves, that are not productive of some apparent evil. It is by means of those very properties which enable them to take up chyle and lymph, and the most powerful remedies, that they take up infectious matter. It must also be remembered, that the human species were not intended to live for ever; and that death is not an evil. Nature has not only provided for our existence and duration for a certain period, but also for our dissolution.

PART II.

CONTAINING

A DESCRIPTION OF THE SITUATION AND NUMBER
OF THE ABSORBENT GLANDS,

AND OF THE

PARTICULAR DISTRIBUTION OF THE ABSORBING
VESSELS THEMSELVES,

IN THE HUMAN BODY.

INTRODUCTION TO PART II.

THE blood-vessels of the human body have been frequently and accurately described by authors. The anatomists who have described parts of the absorbent system are also neither few nor obscure; but the subject is really difficult; they have not hit on the proper methods of investigation; they had not the advantages of proper subjects, and proper instruments; they were not sufficiently masters of their own time; they did not live to accomplish what they had begun; or they laid before the public the produce of a fertile imagination, in the place of a true description.

I have, in another part of this treatise, already taken notice of the anatomists who wrote first on the absorbents; and the reader is supposed to be acquainted with Asellius, Veslingius, Rudbeck, and Bartholine. Their united labours amounted to little more than the discovery of the lacteals, some lymphatics of the liver and testicle, with the thoracic duct. Nor does any one appear, for a long time after, to have added any thing to their stock of knowledge. If I afterwards make it appear, that some other parts of this system were known, yet, as this knowledge was not general, but confined to private societies or persons, and formed what Haller would call crepusculæ lymphaticorum, it will not invalidate the general assertion I have now made. Haller knew all these facts I allude to; yet he says, "Post ea tempora, diu nihil accessit, et multum hæc historia etiam nunc a perfectione abest, neque in omnibus partibus corporis animalis hæc vasa demonstrata sunt, neque systema absolutum est, quale ad arterias corporis humani possidemus. Multæ enim partes corporis sunt, in quibus vasa lymphatica nemo vidit, aliæ ubi et raro quisquam, et cum dubio aliquo.

Ad alia enim incisores se converterunt, eorumque labores rei difficultas vicit."—We have, indeed, been informed, that Nuck had traced the absorbents over the whole body; that he had engraved the appearances, and was going to publish them, when he was prematurely cut off. "Plura promiserat Antonius Nuck, et poterat de ejus viri industria magna incisorum expectatio esse. Integrum enim vasorum lymphaticorum systema amalgamate repletum siccaverat, sed pertinacem in eo labore virum, et per plura animalia sua vascula persequentem, mors ante diem abstulit. Ad ea quæ edidit, utique brutis animalibus usum esse constat, vel cordis exemplo. Non ideo tamen vir. cl. aut J. Henrici Schulzii acerbam accusationem meritus est, aut Laurentii Heisteri censuram, qui tabulas hujus viri pro fictitiis habent. Ipse enim testimonium pro Nuckio dixit Hermannus Boerhaave, tabulasque vasorum lymphaticorum vidit, quæ argento vivo repleta vir industrius continuata siccaverat."

I should be exceedingly sorry to detract from the reputation of any industrious anatomist; but the appearances he has caused to be engraved are not like what I have seen. It is very evident, that he sometimes described from quadrupeds; it is to me also very evident, that he describes from his own imagination. He is right in describing the absorbent glands as cellular; but neither his engravings of those glands, nor some others that I have seen, very much resembling them, are according to nature. Haller, indeed, says of him, "Pari facilitate vasa lymphatica ostendebat ut alii rubra," and that he injected these in vacuo: "Antlia pneumatica ad eum scopum usum fuisse."—He also informs us, that he made use of an amalgam of quicksilver. This does not correspond, however, with what he afterwards says: "Nuckium adipe aliquo argentum vivum coegisse." This mixture would not pass into the absorbent vessels readily, in the way we now inject: I cannot say what might happen, if the vessels were injected in vacuo; but I have a great many doubts on this subject.

Some attempts have since that period been made, and some things have been added to the history of the absorbents, by Mekel, Hewson, and Haller; but the description is still incomplete, as Haller himself confesses: "Ill. Meckelius passim ad eorum historiam aliqua addidit, tum Alexander Monro fil. et potissimum Guil. Hewson, qui multas novas ex humano cor-

pore tabulas dedit, etiam in artubus, et in his non sola cuti vicina vasa, sed etiam profunda, neque prius dicta. Sparsim et ego, et in hominum cadaveribus, et in vivis animalibus, vasa lymphatica et vidi, et persecutus sum. Plurima tamen ubique desunt, neque in artubus, aut dorso, aut interiori capite ea vascula hactenus satis certo visa sunt, neque constitutæ radices aut extremi termini."

The description of the absorbent system I am about to give, is in most things the same with that which I gave at lectures since the year 1773, as I formerly observed, particularly that of the absorbents of the liver, and of the lungs, and pancreas, which were not known to Dr. Hunter himself; the last, particularly, neither to Haller nor Mr. Hewson. Every year I added such varieties as I had discovered. Most of the pupils at Windmill Street took notes; and copies of my description are in the hands of a vast number of students.

I have used, in the First Part of this treatise, for the most part, the terms *lacteals* and *lymphatics*, instead of *absorbents*, in order to avoid all ambiguity concerning the vessels meant; but, having there disproved absorption by red veins, I cannot now be misapprehended, and shall in future employ the term *absorbents*, to signify *lacteals* and *lymphatics*; and shall write *glands of the absorbents* instead of *lymphatic glands.* I must also remark, that neither the glands of the absorbents, nor their vessels, are so constant in their situation and distribution as the arteries; in which respect they resemble the red veins. I have here described them as I found them most frequently.

Another general observation I wish also to premise is, that, independent of those absorbents which accommpany the arteries, and which are usually one, on each side, there is on the extremities a set of cutaneous absorbents, accompanying the larger trunks of the cutaneous veins, as the saphena major and minor, in the lower extremity; the basilic and cephalic veins, in the upper extremity. There is also on the viscera commonly a superficial and a deep-seated set; the first run by themselves, on the surfaces of the viscera; the second accompany the principal blood-vessels of the viscera, and ramify in the same manner. This distinction takes place even amongst the absorbents of the intestines themselves.

Previous to the description of the vessels, I have thought proper to describe the number and situation of the glands of the absorbents, as they are more easily discovered. By this means I shall give an outline of the system, which will facilitate afterwards the description of the vessels themselves.

Many of these glands, from their bulk, may be discovered under the integuments, both by the eye and by the touch. When they are swelled or indurated, they are still more easily discovered; and in the dead body, dissection, with the utmost facility, discovers them in all the other parts where they exist. Both in the description of the glands and of the vessels, I shall begin at the greatest distance from the terminations of the system, i. e. the angles of the jugular and subclavian veins; and follow the course of the absorbed fluids moving in their vessels: consequently, I begin with the lower extremity. I have quoted Haller very often, not only because I consider him as the best anatomical author, on the whole, that we have, but also because I find the anatomical knowledge of all his predecessors collected in his writings. He does not appear to have done much in this system himself; but he knows almost every thing that has been done by his predecessors and cotemporaries.

A
DESCRIPTION
OF THE SITUATION AND NUMBER OF THE
GLANDS OF THE ABSORBENTS.

THE POPLITEAL GLANDS.

I HAVE not seen any glands in the lower extremity, below the ham. Haller makes a similar observation: "Sensim rariores factæ in poplite fere desinunt, cum in tibia, fibula, pedeque nullæ mihi unquam occurrerint." —Mr. Hewson describes and delineates one very small gland a little below the middle of the tibia, on the fore part of that bone, between it and the external integuments; but I have never once met with it; and would therefore consider it as a kind of lusus naturæ. Dr. Hunter once found the glands even of the ham wanting. This circumstance also I never met with. There are seldom more than three; they lie close upon the popliteal artery; and, though small, are by no means, as Haller says, "uti ultimæ conglobatarum, ita minimæ." There are many on the mesocolon, and in a variety of other places, much smaller than they are. They swell from sores on the outside of the foot, in the sole of the foot, and from sores of the integuments on the calf of the leg. Dr. Hunter mentioned a case of a patient who was bit by a mad dog in the calf of the leg: the sore healed at first, but some weeks after broke out again; red lines were perceived running upward from the sore, with the saphena minor, which dipt down in the ham, and were lost. They were inflamed lymphatics going to those glands.

THE INGUINAL GLANDS.

The glands of the groin are of an uncertain number, from eight, ten, or twelve, to twenty or more. Haller makes them only four. " Illas cum plures esse credidissem, accuratius numerans, quatuor inveni; octo faciebat Whartonus." They are situated, principally, above the fascia of the thigh, though several of them lie under it. These last are placed on the iliacus internus muscle, between the triceps and sartorius. Sometimes several of these glands are collected into one large one, which lies on the upper side of the inguinal artery. Those which are nearest the symphysis pubis belong to the absorbents of the parts of generation in both sexes, and become, in the venereal disease, the seat of buboes. In some obstinate venereal ulcerations of these glands, the coats of the subjacent inguinal artery have been so eroded, that from straining the artery has burst, and the patient instantly expired. A case of this kind was related by Dr. Hunter, which happened in a soldier of the guards.—Those on the outside of these last-mentioned are more apt to inflame and enlarge, from scrophulous or other sores on the inside or top of the foot, from sores on the inside of the knee, or any where in the course of the saphena major. They may swell from sores any where on the inside or fore part of the leg and thigh. I have known them swell from wounds of the buttocks, and even from the inflamed and bleeding piles about the verge of the anus. When plaisters, producing ulcers in the integuments, have been applied to the skin, near the spine of the ilium, I have also repeatedly seen these glands swell. They sometimes inflame and suppurate, from sympathy with an inflamed testicle. Haller and Nuck make these glands extend sometimes to the middle of the sartorius muscle: " Aliquousque cum magnis vasorum truncis ad medium fere sartorium descendunt, a quo musculo, *sartoriarum* nomen, Nuckius sumsit, ab arteria, vero, crurales dixit." I have seldom seen any glands between the popliteal and inguinal glands, neither with the cutaneous nor deep-seated lymphatics.

THE EXTERNAL ILIAC GLANDS.

These also are of an uncertain number, from six to eight or ten, or even more, and are situated both above and below the external iliac artery and vein: " A magnis vasis, eædem (glandulæ) cum eorum iliacis ramis cognomines, ad femora tendunt." Though the venereal poison must pass through these glands, in its way to the blood, I know of no instance of their ever forming buboes; and it is very fortunate they do not; for if these, like the inguinal glands, suppurated, they could not be opened by the lancet, they must be left to themselves—might burst; the pus might fall into the cavity of the abdomen; might produce peritoneal inflammation, and might probably destroy the patient. It is very difficult to assign any reason for this, as cancerous matter not only affects the first glands it enters, but all the glands that lie between the sore and the thoracic duct. Some have assigned, as a reason for the venereal virus not affecting the second glands as well as the first, that the poison was diluted by being mixed with the lymph in the first gland. This is by no means satisfactory; since, even after it has been mixed with the whole mass of blood, it is capable of producing ulcers in the throat, blotches on the whole surface of the body, and caries in the bones. The diluting of the semen to an immense degree in water, did not diminish in the least its impregnating powers in the experiments of Spalanzani. Perpaps the internal glands are less irritable to the venereal poison than the more external, (as all the glands of the body are less irritable to mercury than those of the mouth;) or, the first gland inflaming, may prevent the neighbouring glands from inflaming, upon the principle that two inflammations seldom exist near one another, the first preventing all others; or, the greater destroying the lesser, if it had begun in a slight degree.

THE INTERNAL ILIAC GLANDS.

These also have been noticed by Haller.—Speaking of the former class, or external iliac glands, he says, " Ab eo agmine alter fasciculus in pelvim descendit cum vena hypogastrica ramoque ejus obturatorio." Their number is also uncertain; generally, however, more numerous than the former. They are apt to form large indurated masses, from diseases about the rectum, uterus, or bladder, which in many instances have proved fatal. A case of this kind Dr. Hunter attended. A woman was in labour, and could not be delivered in the natural way, from a tumor on the side of the pelvis preventing the child's head from coming down. After she was compleatly exhausted, and the pains gone, he was obliged to deliver by the crochet. The child, of course, was lost; the mother fell into a fever and died. Haller, speaking of the same glands, says, "Funestis schirris obnoxiæ!"

THE SACRAL GLANDS.

Haller blends these with the former class. They are connected with them, undoubtedly; but, lying more in the hollow of the sacrum, and behind the rectum, I have considered them apart. Some of these are a continuation of the glands of the mesocolon, and belong to the rectum; others to the vagina, bladder, and glutæi muscles. "In pelvi ultimas mesentericarum quæ rectum intestinum posteriores comitantur, hæ sacræ iterum adtingunt." These, as well as the former, are liable to schirrus; and have sometimes so compressed the rectum, as almost entirely to prevent the extrusion of the fæces: the patient has been worn out, and destroyed.

THE LUMBAR GLANDS.

The bodies of the lumbar vertebræ, the lower part of the aorta, and cava inferior, are covered with a plexus of lymphatic glands, more numerous than any of the former classes. Under these the thoracic duct takes its origin; so that I am not surprized at Bartholin's considering them to be the real receptacle of the chyle in man. Haller says, "Cum vena cava, porro, anteriores glandulæ descendunt, per lumborum vertebras, lumbalium nomine; celebres toties Bartholina laudatæ, quas vir cl. ob numerosa immista vasa lymphatica, omnino pro vero in homine chyli receptaculo, habuit." These, in cancers, and scrophulous affections of the testicles and ovaria, are frequently enlarged and diseased. "Grandes sunt, et frequenter intumescunt." In the dead body of a man, whose left testicle had formerly been extirpated on account of its being cancerous, I found the lumber glands enlarged to the size of a child's head at birth, and inclosing the vena cava inferior, and aorta descendens, for some way.

THE MESENTERIC GLANDS.

Their number is from between a hundred and thirty, to a hundred and forty or a hundred and fifty.—Ruysch makes them vastly more numerous than I do; and says, that he has counted seventy glands in a portion of the mesentery not broader than the palm of his hand.—Haller does not say how many glands there are in the mesentery, but uses the term plurimæ. "In adipe circa vasorum intestinalium divisiones, plurimæ glandulæ sedent, ovatæ, compressæ, molles, tenera membrana obductæ, conglobati generis, cellulosæ et ipsæ; in mesenterio quidem potissimum, tamen etiam in mesocolo transverso, inque aliis mesocolis, etiam pone rectum intestinum. Iis glandulis cum thymo commune est, succo lacteolo in fetu adbundare, vasculisque innumerabilibus, deinde ea ætate succulentas esse, et in senibus demum diminui, et fere evanescere." This variety depends on this circumstance—the intestinal canal is longer in some human bodies than in others; so much so, that it is sometimes seven or eight times the length of the whole body; at other times not more than three times that length. The number of the glands, and the breadth of the mesentery, are almost always in proportion to the length of the intestinal tube, and of course to the number of the absorbent vessels. As the absorbents are more numerous upon the jejunum, or superior part of the intestinal tube, their glands are not only more numerous, but larger, on that part of the mesentery which corresponds to that intestine. Most of them are situated on the convex or left side of the superior mesenteric artery. In the healthy state of the body, even in the adult, the largest glands on the mesentery seldom exceed the size of an almond. It is very seldom that they are situated nearer the edge of the intestine than one or two inches. They are commonly scattered at a little distance from each other. Sometimes they are clustered, or accumulated; and in many quadrupeds they are only to be found in this clustered form at the root of the mesentery. Asellius found them so in dogs; and, from their forming a line of some length at that place, as well as from other circumstances, supposed them to be the pancreas. Although succeeding anatomists discovered his error, they still continued to call this conglomeration of the lymphatic glands, in those animals, by the name of the Pancreas of Asellius.

I have said, that the glands of the absorbents on the lower part of the mesentery, and towards the right side, are smaller and less numerous than those toward the upper and left side; but the chyle from the lower part of the ilium, if it passes at first apparently through fewer and smaller glands, passes afterwards through a greater number, and even through the large glands at the root of the mesentery; so that what is not strictly true respecting the vessel, though asserted by Haller, is certainly true respecting the chyle absorbed from the ilium. "Idem vas lacteum, quod mihi selegerim, ad quintam usque glandulam, in superficie mesenterii prosecutus sum."

The glands often become enlarged and indurated; this enlargement frequently depends upon a species of dysentery and ulceration of the intestines. The absorbents arising out of the ulcers carry the inflammation to the mesenteric glands, and become the cause of their enlargement. The glands of the mesentery also enlarge from scrophula, without any inflammation or ulceration of the intestines: and, as children liable to this complaint are generally very much emaciated, and soon after die, their emaciation and death has been attributed to the obstruction in the glands preventing the chyle from entering into the blood; and the disease has been called tabes mesenterica, as I have already said. Haller says, "Non alibi, in corpore humano frequentior schirro locus est et steatomatibus etiam lapideis concretionibus, ut omnino dudum earum tumor et schirrus pro causa peculiaris atrophiæ infantilis habiti sunt." After which he exhibits a long list of indurations and enlargements of these glands:—"Schirrus enormis librarum decem—In atrophia mesenterium totum lapidosum—Glandulæ mesenterii tumidissimæ, intus tartaro fetæ."—Diemerbroeck appears to have mistaken the scrophulous suppuration of these glands for the stagnation and coagulation of the chyle in them: "In atrophia glandulæ mesentericæ tumidæ caseoso chylo plenæ." De Haen mentions a case where the mesentery, from the diseased glands, weighed thirty pounds: "Tumor mesenterii cum hydatidibus, etiam cartilagineis partibus, triginta librarum pondere."

THE GLANDS OF THE MESOCOLON.

The glands of the mesocolon are neither so large nor so numerous as those of the mesentery. They are among the smallest in the body; and their number seldom exceeds twenty or thirty. They are situated nearer the edge of the intestine; but are also scattered not only along what is called the mesocolon, but on that fixt production of the peritoneum which belongs to the caput coli, and also to the sigmoide flexure of the colon. They are also found on what Haller calls the mesocolon inferior, in the hollow of the sacrum, what Dr. Hunter used to call the mesorectum. Haller says little or nothing of these glands: "Numerosissimis illis mesenterii et mesocoli glandulis conjungitur." The mesenteric glands, at the time of the absorption of the chyle, are of a pure white colour; but I never saw this happen to the glands of the mesocolon. Winslow says, that he demonstrated, to the Academy of Sciences, chyle in the lacteals of the great intestines. This I have already observed I never saw. The chyle is principally found in the jejunum; and the contents of the ilium, towards its lower end, approach very much to the nature of fæces. In the great intestine I have never found any thing but fæces. The circumstance of the glands being more numerous in the mesentery, along which almost all the chyle is carried, and being smaller and less numerous on the mesocolon, through which hardly any passes, looks as if the glands were intended to produce some remarkable change on the chyle. These glands are not so liable to schirrus as those on the mesentery; but are sometimes enlarged, from cancers and schirri in the great intestines, which occur there more frequently than in the small.

THE GLANDS OF THE OMENTUM AND STOMACH.

It is seldom that any glands are found on the omentum till you come near the great arch of the stomach; they are about three or four in number, in the course of the gastrica dextra and sinistra; and, though they belong to the omentum as much as to the stomach, have been considered by some anatomists as belonging to the stomach only, and been termed glandulæ ventriculi inferiores. There are some small glands also on the edge of the little epiploon, where it adheres to the small arch of the stomach; these, from their situation, have been termed glandulæ ventriculi superiores.

THE GLANDS OF THE LIVER, PANCREAS, AND SPLEEN.

The trunk of the vena portarum, near its entrance into the liver, is surrounded with absorbent glands; these I have seen diseased, and distended to an enormous size, and compressing both the ductus communis choledochus, and the pancreatic duct, at the place of their insertion into the duodenum: this produced constipation, white stools, jaundice, and a train of hypochondriac symptoms. This plexus is connected with another, which runs in the course of the splenic artery and vein, and belongs to the stomach, pancreas, and spleen.

GLANDS OF THE THORAX.

These divide themselves into six classes; those of the diaphragm; those which accompany the arteries mamariæ internæ; those of the heart and aorta; those of the lungs; those of the œsophagus; and those of the spine and intercostal spaces.

GLANDS OF THE DIAPHRAGM.

There are five, six, or eight in number, very constant in their situation, and may be found almost always on the anterior or upper surface of the diaphragm before, and to the right and left of the pericardium: commonly these glands belong as much to the liver as to the diaphragm, and may, of course, be morbidly affected, either from the diseases of the liver, or of the diaphragm only; sometimes I have seen them belonging to the diaphragm only: the absorbents of the liver, which usually perforate the diaphragm passing under it and downwards, instead of upwards, to the lower part of the thoracic duct.

MAMMARY GLANDS.

These are smaller than the former, and like their vessels, are situated by the sides of the mammary veins, at small distances from each other, to the number, sometimes, of ten or twelve; I have seldom seen them diseased, except in scrophulous children, and they are commonly so small, as to escape cursory observation.

CARDIAC GLANDS.

These are larger than the last described, seldom more than four or five in number, and situated either on, before, or behind the arch of the aorta: those belonging to the right side of the heart, are usually found between the origins of the right and left carotids; those of the left side, between the arch of the aorta and anterior surface of the trachea, and in some diseases of the heart, are found also diseased.

PULMONARY GLANDS.

By this term, anatomists understand either the secreting smaller glands of the internal surface of the trachea, and air-cells, or the larger, not secreting, but absorbent glands at the root of the lungs, on the outside of the bronchiæ; here I mean only the last. Haller says, " quæ cum arteria aspera descendunt eæ pariter ejus ramum comitantur et pulmones grandia vasa circumstant et arteriores et posteriores." These are still larger than those of the heart, eight, ten, or twelve in number, communicating with the cardiac glands, and always diseased and enlarged in pulmonary consumptions: they sometimes contain a black fluid, their internal substance then seems broke down and dissolved, so that they feel soft and pulpy, and when cut into, resemble so many bags of ink; at other times, they are full of ossifications, which sometimes by ulceration, make their way into the trachea, and bits of bone have been coughed up from the lungs, where naturally there is nothing bony: bits of bone, however, may be coughed up from the lungs from other causes. Dr. Hunter related a case, and shewed the basis of the cricoid cartilage, which ossifying first, and then dying, from some unknown cause, exfoliated, and was coughed up; the patient, for some months before, spit blood and pus, in greater or smaller quantities, and was supposed to be in a consumption, but on coughing up the bone, he recovered: some glands are also continued from these, on the fore part of the trachea, all the way to the upper edge of the sternum. I once knew an instance of these glands becoming schirrous, and forming a considerable mass, which being prevented by the sternum from pushing forwards, pressed backwards upon the trachea, and compressed it in such a manner, that its cavity was gradually obliterating. The man was for some time incapable of the least exertion or motion, without running immediate risk of suffocation; and actually died one morning suddenly, as he was putting on his cloaths.

Tubercles of the lungs, are, by some, supposed to be indurations of the absorbent glands; by others, to be indurations of the simple glands or follicles, but they are totally distinct from either. There are very seldom any lymphatic glands within the substance of the lungs, and when I have found them, they extended a little way only, and always adhered to the outside of the large branches of the trachea. Tubercles of the lungs are little scrophulous abscesses in the cellular membrane at first, and afterwards in the air-cells of the lungs; this pus is not fluid, like common pus, but hard, and resembling particles of cheese. When first deposited, it is transparent, and the vessels which deposite it, resemble the vessels which forms specks or opacities on the tunica conjunctiva of a scrophulously inflamed eye. These tubercles gradually become opaque, spread over the substance of the lungs, and though separate at first, gradually run into one another, and render the lungs at last one solid mass, like a schirrous liver. They remain often indolent, even for years, and are marked by a dry cough, and occasionally, small spittings of blood; they sometimes kill in their advanced state, by depriving the patient of the full advantage of respiration and other circumstances connected with it. Sometimes they melt down into common pus, and then ulceration of the lungs takes place, with copious purulent bloody expectoration, from which, perhaps, no patient ever recovers. I have known, however, a patient survive the destruction of the whole of the left lobe of his lungs for some months, the other lobe, by which only he could breathe, remaining tolerably sound. I once saw the lungs, the liver, spleen, the great and small intestines, beset with tubercles, in a child, who died, six weeks after inoculation: the child was quite well at the time of the inoculation, but soon began to droop. I saw also in the dead body, at the same time, most of the absorbent glands in a state of scrophulous induration; whether any disease was communicated along with the small pox, or that the action of the variolous infection roused some latent disposition already in the child, and brought it into action, I do not know.

ŒSOPHAGEAL GLANDS.

These surround the œsophagus externally, through its whole length, from ten, twenty, to forty in number, but admit in this respect of great variety in different bodies. Vesalius describes one very large, about the middle, which he supposed poured its fluid into the œsophagus, instead of receiving it from it. We easily forgive this fault in so great a man, at such a period. These glands enlarge and indurate, and, according to Haller, form strictures of the œsophagus, by pressing its opposite sides firmly against each other: he says he has cured these indurations by quicksilver, camphor, and aloes, rubbed down, and even by the oleum tartari diluted with water:—" Curavi autem eos ægros argento vivo cum camphora et aloe composito ut per alvum pituita sanguine tincta decederet; alium etiam nuper oleo tartari per deliquium in multo aqua dato."

INTER-

INTERCOSTAL GLANDS.

These are often situated two and two by the heads of the ribs, and I have injected them sometimes from the thoracic duct, contrary to the course of the valves; they are very small, but perfectly distinct, and, unless in very scrophulous children, they are never so enlarged as to be very remarkable. They seem to be placed there as so many guards on the thoracic duct, that nothing unchanged should be permitted to pass into it.

THE GLANDS OF THE NECK.

The glands of the neck are almost as numerous as those of the mesentery; they are situated chiefly on the sides of the neck; some of them lie immediately under the skin, and accompany the external jugular veins; but by far the greater number accompany the internal jugular veins and carotid arteries. " Porro hæc glandularum series cum pharynge continuatur et ad latus et ad posteriorem ejus faciem, secundum iter jugularis venæ et carotidis arteriæ——Verum agmen illud jugulare dextrum cum vena cava, utriusque vero lateris cum aspera arteria continuatur." Haller. These glands frequently swell in children, from scald heads, runnings of the ears, inflammations of the gums, and alveolar processes in teething, and recover after the teething, &c. are over, constituting what Sauvages calls *scrophula fugax*; that is, an apparent, transient, not real scrophula: such swellings of the glands take place between three and five years of age. They frequently swell and enlarge from suppurations and ulcerations of the integuments on the top of the head, in adults not scrophulous; and they frequently inflame and enlarge from scrophulous disposition alone. I have known them swell to an enormous size; and, though commonly accompanied with little pain, I have known the inflammation changed from inert to active; and the pain and irritation of the parts, together with the affection of the mind, have worn out and destroyed the patient. Commonly, however, the scrophulous affection of those glands is more offensive to the eye of the spectators, and troublesome to the patient, than dangerous. As they are situated in parts which are not usually covered, they are exposed to every body's view, and almost constantly excite the idea of scrophula, and of the blood's being tainted with an hereditary disease, which may be communicated to the offspring of the person. The inflammation of those glands not unfrequently terminates in suppuration. They burst of themselves, continue discharging for months or years, or alternately heal and break out again, till the age of fourteen or sixteen; when the increased vigor of the constitution, and the changes that take place respecting the organs of generation, put a stop to the disease, the patient for the remainder of his life shews no more symptoms of scrophula, or at least not till towards the end of life, when the vigor of the body declining, permits this disposition again to shew itself. These glands not only enlarge from particular affections of the teeth and jaws, and of the integuments on the outside of the head, but from affections of the brain and its coverings; a proof not only of there being absorbents in the brain, but of the course which these absorbents take. These gland also swell from ulcerations of the integuments in the nape of the neck.

THE GLANDS OF THE AXILLA.

These last mentioned glands blend in with another plexus, situated under the clavicles and in the axillæ; these are not so numerous as those of the neck, though in general they are larger. They belong to the absorbents of the arms, of the breasts, and of the integuments behind the scapulæ; and inflame and enlarge in particular affections of those parts. They even receive absorbents from the cavity of the chest; and I have known them swell from pleurisy, peripneumony, and pulmonary consumption. A nerve from the second dorsal perforates the intercostal muscles, and also goes to the axilla, at the same place with these absorbents. These glands, particularly, swell in cancerous affections of the breasts of women. It is sometimes possible to extirpate them with the diseased breasts themselves, but more frequently their swelling on these occasions is a mark of the disease being incurable; and I have known them form a schirrous mass, and surround the axillary artery in such a manner, that it was impossible to extirpate them, without extirpating that part of the artery too. In most of the cases of cancer in the breast, where these glands have been extirpated, the disease returns, because it is almost impossible to find out or extirpate all the infected glands; or the arm some time after becomes œdematous, because the trunks of the absorbents have been cut through, and afterwards included in the cicatrix.

GLANDS OF THE ARMS.

These are also of an uncertain number, from three to six or seven in each arm, and placed in no certain order: they occupy the inside of the arm, from the axilla to the internal condyle of the humerus, where there is almost constantly one gland, in each arm, to be found on the anterior surface of that condyle. They run principally with the brachial artery. I have known the last-mentioned glands die, and slough out in scrophula, without any great inconvenience.

GLANDS OF THE FACE.

There are some small glands belonging to the absorbents on the sides of the face; the uppermost of these are immediately under the zygomatic processes of the temporal bones, others lie on the external surfaces of the parotid glands, as well as on the buccinator muscles. There may be four, five, or six of each side; sometimes there are none. There are also seve- glands about the angles of the lower jaw, and on its base, between these angles and its symphysis. There are constantly two behind and upon the mamillary processes of the temporal bones, but these are rather to be considered as the uppermost of the neck, than belonging to the head.

WHERE THERE ARE NO GLANDS OF THE ABSORBENTS.

Having thus pointed out in what parts of the body the absorbent glands are chiefly to be found, it will naturally be asked, Are there no glands to be met with in the other parts of the body? I do not say that they are never found any where else. Anatomists may yet find them in parts where I have not seen them. We are every day finding some lusus naturæ in the arteries, veins, and nerves; and, as the absorbent system allows of a still greater variety, other glands may yet be seen than those which I have described. But I have seen no glands on the feet, none on the legs below the ham, none between the integuments of the thigh and the muscles, different from those described. Others have seen those that sometimes, as it would appear, accompany the femoral artery in the middle of the thigh; I have seen none between the ham and the groin. I never saw any either under the integuments or among the muscles of the nates. I have met with none, on the posterior part of the trunk of the body, different from those I have already described: nor on the anterior part, except some small ones on the breasts of women, situated between the nipple and the axilla. There are none on the hands. I never saw any on the fore-arm. This winter I have seen some, for the first time, about three inches below the olecranon on the posterior side of the ulna, immediately under the skin. There are none on the outside of the cranium; none in the inside, either in the coverings or in the substance of the brain. The pituitary gland has some resemblance to the glands of the absorbents; but when cut into, it evidently consists of two substances; in which respect it resembles the renal capsula of quadrupeds: one upon the outside, which may be called cortical; and another on the inside, which, were we to compare it to the substance of the brain, may be called medullary. There is nothing of this appearance in the glands of the absorbents of the human body. No absorbent vessels have been yet traced into it; we therefore do not know whether it is or is not a gland belonging to the absorbents.

OF THE
PARTICULAR DISTRIBUTION
OF THE
ABSORBENT VESSELS THEMSELVES,
IN THE DIFFERENT PARTS OF THE BODY.

ABSORBENTS OF THE LOWER EXTREMITY.

I HAVE, in a former part of this work, demonstrated that the trunks of the absorbents are at least double the number of the larger arteries. Some have imagined that this superiority in number did not extend to the minute branches; but the annexed engraving of the deep-seated lacteals will sufficiently demonstrate that this superiority in number is kept up there also. I have occasionally seen, immediately under the common integuments on the top of the foot, innumerable ramifications of the absorbents, and exactly the same appearance as in the ramification of arteries themselves. Bartholin and Steno appear first to have seen something of these vessels in quadrupeds; but Van Horne was the first who saw them in the human subject. This I take on the authority of Haller: "Ea vero in humano crure ostendit Johannes Van Horne." The large absorbents of the lower extremity are formed into two sets, superficial, and deep-seated; the superficial set accompany chiefly the cutaneous veins, and the deep seated accompany the arteries. The cutaneous veins of the lower extremity form two principal trunks; one of these is named saphena major, and the other saphena minor. The greater number of the cutaneous absorbents accompany the saphena major. Some absorbents arise from the sides of the toes, in the same manner as the arteries, two and two. But, besides these, there is a net-work of absorbents compleatly surrounding the toes. The two lateral absorbents accompany the deep-seated arteries; the net-work upon the outside belong to those which accompany the cutaneous veins. They form four great divisions; the first arises from between the great toe and the one on its outside, where the saphena major commences, and consists of six or seven vessels; they run over the top of the foot, with that vein, towards the fore part of the inner ancle; from thence they run, in company with the vein, towards the inside of the knee, where they are joined by others, presently to be described. The second division, which I have seen consisting sometimes of eight or ten vessels, arise about the middle of the inner edge of the foot, pass behind the inner ancle, and, running over the inside of the calf of the leg, join the last-described vessels on the inside of the knee. The third division, consisting of five or six vessels, arise near the little toe, run over the outer and upper side of the foot, in the direction of the outer ancle; when they come near it, they divide into two; one part cross over the anterior part of the tibia, and go likewise to the inside of the knee, where they join the two former divisions.—It happened once, that when I was injecting this plexus with quicksilver, I injected a portion of the skin to great minuteness, the mercury having run contrary to the valves, into exceeding fine extremities of the absorbents. The part where this happened, as well as the vessels from whence it was injected, are seen in plate I. left leg.—From the union of these three divisions, a grand plexus is formed, consisting of fourteen, sixteen, or twenty trunks, which still continue to accompany the saphena major; that is, to run obliquely from the inside of the knee to the middle of the groin; there they commonly go into the different inguinal glands already described. But, in the most successful injection that I ever made of these vessels, they terminated in one gland, as will be seen in plate I. It frequently happens, that two or three of these trunks pass by the glands of the groin, and are not inserted into any gland till they have passed under Paupart's ligament. Part of the last division, viz. that coming from the little toe, join another which arises from the middle of the outer edge of the foot, where the saphena minor commences, and accompanying that vein, pass behind the outer ancle; from thence run on the outside of the tendo Achilles, go afterwards between the bellies of the gastrocnemeus muscle, and, dipping down between its heads, near the place where they are inserted into the condyles of the os femoris, terminate in the glands of the ham, already described. These are not above one fifth so numerous as the former. The deep-seated absorbents arise, as I have said, from the sides of the toes, along with the arteries, two on each side, as the deep-seated veins. Part of these accompany the anterior tibial artery, on the top of the foot; they accompany it through its whole course; with it perforate the interossial ligament, between the tibia and fibula, and terminate in the glands of the ham: but the principal part accompany the arteries plantaris externa and interna, in the sole of the foot, and afterwards the posterior tibial artery through its whole course, and terminate also in the glands of the ham. I have once or twice also seen the absorbents accompanying, in the same manner, the peroneal artery. Though I have not injected them with quicksilver, I have inflated them with air, and have no doubt but that they terminate in the same glands. From the glands of the ham, two grand trunks emerge, as vasa efferentia principally to the deep-seated absorbents now described, but also to the cutaneous absorbents which accompanied the saphena minor; these run one on each side of the femoral artery. These frequently communicate with one another by cross canals, and their branches sometimes form circles which compleatly surround the artery. In one case they both terminated in the same gland in which the greater number of the cutaneous absorbents had terminated; but more frequently they terminate in three or four of the larger glands, which lie on the upper or under side of the inguinal artery. The glands and the vessels together I have usually named *plexus inguinalis.* From these glands several trunks emerge. I have occasionally seen two; sometimes four; and, the very last time that I injected them, which was in the summer of the year 1785, there were six: these I have been used to name *efferentia inguinis.* The principal trunk lies under the fascia of the thigh, immediately in contact with the upper side of the inguinal artery, and a little above that passes under Paupart's ligament, where it immediately enters into the glands that are upon the sides of the external iliac artery; and, being joined with other smaller trunks from the thigh, forms a plexus of vessels and glands, all the way to the lowermost vertebra of the loins; which I have usually distinguished by the name of *plexus iliacus externus:* sometimes the principal trunk, without entering any gland, accompanies the iliac artery till it is lost in the lumbar glands. I have sometimes found it passing along these, without entering any of them, and going immediately into the beginning of the thoracic duct, where, joined by a similar trunk from the opposite side, they might be said, as it were, to form the two crura of the thoracic duct. Some of the smaller vasa efferentia of the groin lie above the fascia of the thigh, and, before they pass under Paupart's ligament, perforate the fascia in so many different places. When the absorbents of the thigh form one large trunk, lying on the upper side of the inguinal artery, I have distinguished it by the name of *efferens inguinis maximum*; its size is described page 87: Dr. Hunter had forgot that he himself had seen it; but, in his posthumous notes, I find that six inches of the femoral artery had been brought to him in 1764, from an hospital in town, with this trunk of the absorbents on its upper surface, distended with its own lymph. He says it contained a straw-coloured liquor, and was almost as large as a goose quill; it was found full on dissection, and its fluid was prevented from running out by a ligature then put round it, and the upper part of the artery: he says the vessel was as tight as it could have been made by any injection. If the operation for the inguinal aneurism was to be performed in such a case, this trunk must be tied up with the artery, the leg must become œdematous, and there would be a stagnation of lymph in almost all the absorbents of the lower extremity. About two years ago I injected the trunks accompanying the femoral artery: a little above the middle of the thigh they split into four branches; these subdividing, formed about seven or eight; some of these were inserted into glands on the inside of the inguinal artery, but the principal vessels went with it under Paupart's ligament, into the cavity of the abdomen, and were inserted into the external iliac glands.

THE ABSORBENTS OF THE PENIS.

These likewise may be divided into a superficial and deep-seated set. The superficial absorbents arise from the prepuce, in three divisions; one on the right side of the frænum, another on the left, and the third directly in the middle, on the superior side. Those from the under side make a semicircular turn, from the under to the upper side of the penis; whilst that on the superior part of the prepuce runs on the middle of the dorsum penis, exactly in the direction of the symphysis pubis. At a little distance from the symphysis, the three divisions unite into one common trunk, which almost immediately separates again into two. One of these trunks goes to the right groin, accompanies those veins which go to the inguinal vein, and terminates near it in those inguinal glands which are nearest the symphysis pubis. The other trunk goes to the left groin, and terminates exactly in the same manner as the former. It is from this circumstance, that when venereal matter is absorbed from a chancre on the prepuce, red lines are sometimes seen running on the body of the penis, and terminating in the groin: these are the absorbent vessels inflamed by the irritation of the poison. This inflammation seldom lasts above a day or two. At other times they put on the appearance, and have the feel of small cords: these also go off in a few days. At other times the vessels not only inflame, and form indurations, but also suppurate in different places, and form what has been called buboes of the penis. The deep-seated ones accompany the arteries, and pass with them on the inside of the tuberosities of the ischia, or under the angle of the pubis. If the venereal virus forms a chancre on the prepuce, a buboe is frequently the consequence, in one of the glands of the groin; but if the chancre is formed on the glans penis, there is seldom a buboe in the groin, and yet the constitution is infected as certainly as in the former case. The inguinal glands sometimes inflame and suppurate merely from sympathy with the urethra, though no venereal matter be passing through them: this we see sometimes in gonorrheas cured without mercury; where, no symptoms of the lues venerea in the constitution appeared afterwards. The same thing frequently happens when bougies have been introduced, with a view to the cure of a stricture in the urethra.

THE ABSORBENTS

OF THE EXTERNAL PARTS OF GENERATION IN WOMEN.

The absorbents from the clitoris, and beginning of the vagina, also form two divisions; one of these, as in the male, goes to the inguinal glands of each side; the other runs up with the round ligaments towards the rings of the external oblique muscles of the abdomen, and may either pass into the glands on the inside of Paupart's ligament, or, blending with the absorbents of the uterus, most probably terminate in the lumbar glands. This arrangement of these vessels will explain what we commonly see taking place, as the consequence of chancres in women—If the chancre is near the meatus urinæ, the red lines, which mark the inflamed absorbents, are sometimes seen running in the course of the round ligament; and suppurations, similar to the buboes of the penis in men, also sometimes take place; but if the chancre be situated any where near the perineum, the red lines are seen running in the direction of the groin, and the buboe has the same situation that it usually has in men.

SOME OTHER ABSORBENTS,

TERMINATING IN THE GLANDS OF THE GROIN.

I have seen absorbents injected with quicksilver, which arose from the buttocks and posterior part of the thigh, and which, passing between the integuments and muscles of the outside of the thigh, were inserted into those inguinal glands which are nearest the spine of the ilium. The following appearances shew, that the absorbents about the verge of the anus, as well as the absorbents of the lateral part of the abdomen, are inserted in the glands of the groin. Where piles have been very much inflamed or suppurated, I have repeatedly seen the inguinal glands swell; and where ulcerations have been produced in the integuments which cover the posterior edge of the obliquus externus, the absorbent glands of the groin have also swelled.

ABSORBENTS OF THE SCROTUM.

These go with the cutaneous veins of the scrotum to the groin, and sufficiently account for that swelling of the absorbent glands there, which is commonly ascribed to sympathy with the testicle, for the scrotum also sends vessels to the body of the testicle, which have sustained its life when the spermatic artery has been destroyed. From this anastomosis of vessels it is easy to conceive that turgescence of the vessels of the testicle, may occasion a turgescence of the vessels of the scrotum. The inflammation of the scrotum is at first often erysipelatous, and frequently extends itself to the neighbouring absorbent glands, through the medium of the absorbents.

THE ABSORBENTS OF THE TESTICLE

May be divided into four classes: those of its coats, those of the body of the testicle, those of the rete testis, and those of the epididymis. The first I have usually distinguished by the name of *lymphatica tunicæ vaginalis*; the second, by the name of *lymphatica testis propria*; the third, *lymphatica rete testis*; and the fourth, by the name of *lymphatica epididymidis*. The absorbents of the tunica vaginalis are easily discovered, lying between the reflection of that coat and the tunica albuginea. Though they are thus situated, I know that they belong equally to the body of the testicle: they are in great numbers, and I have sometimes shewn the albuginea covered with absorbents injected with quicksilver; perhaps there is not any part of the human body where the absorbents are larger or more numerous, in proportion to the part, than here. They soon leave the albuginea, and get upon the cord, where they are joined by others to be described presently; but the tunica vaginalis has also other absorbents, upon the anterior and lateral parts, which have not the least connection with the body of the testicle, nor with the albuginea, and which also soon blend with the former, on the beginning of the cord. The absorbents which arise out of the rete testis are exceedingly large, and appear to have no connection with its coats. A very beautiful preparation of these vessels I made in 1777: I injected the vas deferens with quicksilver, and had in view not only the filling of the epididymis, but the tubuli testis themselves. I had forced the mercury along the epididymis, and was delighted to see it get into the body of the testicle; the mercury continued to descend very quickly through the glass injecting tube, but I soon found that it was not running into the tubuli testis, but into some vessels which mounted along the cord; these I soon perceived were absorbents. The preparation was dried, afterwards put into oil of turpentine; the absorbents are distinctly seen rising out of the rete testis. I have also injected them from every part of the epididymis, from its superior extremity, from the middle, and from the lower end. The vasculum aberrens Halleri is not an absorbent vessel, and cannot possibly return the semen to the blood; it is a lusus naturæ, and sometimes is a tube closed at the opposite end, or, after many convolutions, returns back again upon itself, and terminates where it began. It sometimes mounts four inches upon the cord, and then terminates. Sometimes it is not a quarter of an inch in length. I have seen it convolute like the epididymis itself; from which it could not be distinguished, till by maceration and dissection the cellular membrane had been removed. It may be compared with the diverticulum ilii, so frequently met with in the human intestines. The absorbents having reached the cord, form from six to twelve trunks, or more; some of these are sometimes larger than a crow-quill: they do not appear to anastomose with one another as they pass along the cord; at first they run straight upwards, in the direction of the ring of the external oblique muscle; after which they are bent upon themselves, and pass a little way in the direction of the spine of the ilium; after which they are bent as it were a second time upon themselves, and run over the anterior surface of the psoas muscle, and terminate at last in the lumbar glands. The reason of their termination, so distant from their origin, will easily occur to those who reflect that the original situation of the testicle was at this place, and that it was natural for it, like the other viscera, to receive its blood-vessels and nerves from the nearest trunks, and to return its absorbents to the nearest glands. I have already said, that, in schirrus or cancer of the testicle, these glands were sometimes infected, and enlarged to an immense size. Nuck appears to have been the first who saw the lymphatics of the testicle. Haller says, " Olim Cl. Nuckius flatu per venas spermaticas impulso hæc vasa distenderat, et ad quadraginta vasa lymphatica ex albuginea tunica nasci, in quinque ramos confluere, suamque lympham in cisternam chyli deponere docuerat: aliud vero vasculum cum ductu deferente ad ureteram tendere, pariterque prope renes in cisternam finiri. Ligatis vasis spermaticis, Graafius utebatur, et ejus præceptor Sylvius." There is a circumstance in this description which renders it suspicious; that is, his asserting that they terminated immediately in the receptacle of the chyle. In all my injections of those vessels, they have constantly terminated in the lumbar glands. Dr. Joliffe appears to have been the first who saw those vessels on the spermatic cord of the living human subject, as I have formerly observed. Haller appears also to have seen them, but, with his usual candor and modesty, confesses that he knew very little either of their origin or termination. " In homine aliquoties vidi majuscula, non tamen valde numerosa, in funiculo seminali cum venis adscendentia, valvulosa, ut tamen neque originem, neque finem satis accurate viderem."

THE ABSORBENTS OF THE UTERUS.

As the uterus has two sets of arteries and veins, it has also two sets of absorbent vessels: one of these is the largest, and accompanies the hypogastric arteries and veins; I have usually named them *lymphatica hypogastrica.* The other is smaller, and accompanies the spermatic arteries and veins; and which I have usually distinguished by the name of *lymphatica spermatica.* In the gravid uterus, the trunks of the hypogastric absorbents are as large as a goose-quill, and the vessels themselves so numerous, that, when they only were injected with quicksilver, one would have been almost tempted to suppose that the uterus consisted of absorbents only. In the unimpregnated uterus they are not so easily detected; but, when that viscus has been injected by the arteries and the veins, and has afterwards been macerated in water for some days, the air then produced in the cellular membrane, by putrefaction, gets into the absorbent vessels, and makes them perfectly distinct. The hypogastric plexus pass from above downwards, into glands which are situated on the sides of the vagina; which enlarge, as the vessels themselves do, in the impregnated state, though they are almost invisible in the unimpregnated state: from these glands the trunks of these vessels pass to other glands, surrounding the internal iliac artery and vein, and which have been already described; these glands and vessels together I have distinguished by the name of *plexus iliacus internus:* from these they pass into the lumbar glands, and there blending with the trunks from the lower extremities, they pass into the thoracic duct. On the internal surface of the gravid uterus, at that part where the placenta had formerly adhered, I have seen quicksilver, which I had thrown into these vessels from the external surface of the uterus, escaping at torn extremities of vessels which had been passing into the placenta, even contrary to the valves.

The absorbents which accompany the spermatic artery and vein are neither so large nor so numerous as the former; they belong chiefly to the ovarium, fallopian tube, and the round ligament; they anastomose with the former in such a manner that they are frequently injected from them; this cannot happen in any other way than contrary to the valves. They run up on the spermatic cord, without passing through any gland, till they come to the same place where the absorbents of the testicle terminate in the male; there they also terminate, in glands situated on the sides of the vertebræ of the loins: from these glands they pass out, and blending with the lumbar plexus, get into the thoracic duct. In quadrupeds the absorbent vessels of the uterus are very easily distinguished, and they ramify exactly as the arteries and veins. I have frequently injected them with quicksilver, in vast numbers, with the same facility, nearly, that I injected the arteries and veins; there are commonly one on each side of every artery, so that they are exactly double their number.

The absorbent vessels of the human uterus were first seen by Mery, afterwards by Morgagni and Winslow. Haller says, " Vidit in humano utero Johannes Mery, in omnibus ad instrumentum genitale pertinentibus partibus; tum I. B. Morgagnus in puerpera, turgida, sub membrana externa uteri repentia; et I. B. Winslow."

He himself appears never to have seen them: "Etsi in homine ea vasa nunquam mihi contigit vidisse, vidi tamen in majoribus bestiis etiam manifestissima."

THE ABSORBENTS OF THE BLADDER.

These, in both sexes, accompany the principal veins on the bladder, and at the bottom, on the right and left side, pass into the gland, surrounding the internal iliac artery and vein, but previous to this, they frequently pass into small glands situated on the sides of the bladder itself. Zellerus has given a description of those vessels, in a treatise which I have not seen. Haller says, "Zellerus vasa lymphatica (vesicæ) injecto vinculo confirmavit;" and, though Haller had not seen the absorbents themselves, he had seen the small glands which I have mentioned, and for that reason has no doubts of Zellerus's description. He says, "In vesica quidem non vidi, sunt tamen in cellulosa tela, ei circumposta glandulæ conglobatæ, quæ rei fidem faciunt."

THE ABSORBENTS OF THE RECTUM.

As the blood-vessels of the rectum are in proportion larger than in most parts of the great intestines, so are its absorbents. It is also surrounded with absorbent glands. Mr. Hewson says, "The lymphatic vessels arise even from the rectum, as can be seen in quadrupeds that are opened immediately after death, or in fish, when a coloured injection is thrown into their lymphatic system." He seems to me to have had no adequate idea of the absorbent system: I could as easily conceive a part to be without arteries and veins, as without absorbents. Haller says, "Qui negaverunt crassis intestinis lactea data esse, ii non satis ad difficultatem negationis universalis adtenderunt." Mr. Hewson might have known, that the absorbents of the rectum were the first discovered after those of the liver, by Rudbeck; and, from the authority I last mentioned, it appears, "Prima etiam lymphatica vasa, quæ præter hepar in homine visa sunt, ea in recto intestino adparuerunt." Auerbach also asserts, that he had seen the absorbents of the rectum in the human subject, with his naked eye; "Sibi nudo oculo in elapso intestino visa esse." Haller is here obliged to reject the existence of the ampullula; and the reason he gives us is, that there are no villi formed on the internal surface of the rectum. He says, "Cum villi hic nulli sint, necesse est, etiam alio modo et absque ampullula, chylum de intestino posse sorberi." The lymphatics of the rectum, having passed the glands that lie upon it, terminate at last in the lumbar glands, where, blending with the larger trunks of the absorbents, already described, the fluids they have absorbed are carried to the thoracic duct.

THE ABSORBENTS OF THE HIPS.

These I have usually distinguished by the name of their attendant arteries *glutea* and *sciatica.* Some of these, I have already said, go round by the great trochanter of the thigh to the glands of the groin; or pass on the inside of the thigh, between it and the scrotum, to the same glands: but by far the greater number go in at the sciatic notch, with the arteries glutea and sciatica, and terminate in the glands surrounding the internal iliac artery and vein; and when they have passed through those glands, they terminate at last in the lumbar glands, from whence their fluids go into the thoracic duct.

THE ABSORBENTS OF THE KIDNIES.

The absorbents of the glandular viscera are commonly found in two sets; one which runs on the external surface of the viscus, and another deep-seated, which accompanies the larger blood-vessels. In the sound state of the kidney, I have very seldom seen the superficial absorbents; but in cases where the kidneys were diseased, and formed into large hydatids, those vessels, which, in the sound state of the viscus, from their minuteness are with great difficulty seen, having enlarged with the diseased parts, become perfectly distinct. They run from the outer edge of the kidney towards the inner, where they either blend in with the deep-seated set, or go separately to be inserted into the lumbar glands, already described. Nuck's engravings of these vessels appear to me very suspicious. In a diseased kidney, where its substance, in consequence of stones being contained in the pelvis, had shrunk, and left the principal branches of the veins and arteries naked, I injected nine absorbents with quicksilver; which run upon the outside of the blood-vessels, and ramified as they did. When they came near the trunks of the emulgent artery and vein, they were more closely collected into a plexus, and, running nearly parallel to each other, terminated at last in the lumbar glands, a little to the outside of the origin of the emulgent artery. By making a ligature upon the emulgent vein, and compressing the substance of the kidney, whilst it was in *situ*, I have forced the blood which had transuded into the cellular substance of that viscus, into the mouths of the absorbents, and thence into their branches; they have then shewn themselves to have been exceedingly numerous, at least equal to the blood-vessels. It is in this state I have represented them, in the substance of the kidney, in the large figure annexed.

There is also in the kidney another set of absorbents, belonging to the pelvis and ureter. I attempted to inject, if possible, the tubuli uriniferi with quicksilver from the ureter; for this purpose I increased the column of mercury as much as I could; but, instead of filling these vessels, the mercury returned through the lymphatics on the outside of the ureter, and ran in the direction of the inferior lumbar glands. "Trunculos quidem in omni cadavere facile est in vena renali detegere, per quos ipse ductus thoracicus non incommode repletur, in quem se conferunt. Non ita facile est in renes deducere: quare artificium solent addere, venamque ligant, et per arteriam aquam impellunt, aut per venam, per ureterem denique: aut vasa certe venosa renis ligant, quo vincula una ea vasa comprehensa ex sua indole turgescunt. Denique sola putredo, quæ cellulas inflat, etiam vasa lymphatica patefacit." Haller.

THE ABSORBENTS OF THE RENAL CAPSULÆ.

The principal veins of the renal capsulæ join the emulgent veins; so do their principal absorbents join those of the kidnies, and of course have the same termination. I have frequently observed the absorbents of the neighbouring parts passing over the renal capsulæ, and blending with their absorbents. Heuerman says, he has seen at least seven or eight lymphatics arising out of the renal glands. Haller's expression is, "Etiam in capsulis renalibus aliqua (lymphatica) visa sunt."

THE ABSORBENTS OF THE INTESTINES.

I have already said, that Erasistratus had seen the lacteals in kids, but supposed them to be arteries.—Haller says, "Vasa lacte plena invenit, sed præjudicio claudente oculos, inanes arterias, ad suam hypothesin putavit se videre."—Herophilus also, about the same time, appears to have seen the same vessels, which he distinguishes by the name of the nutrient veins. The same author observes, "Eodem fere tempore Herophilus, magnus incisor, in junioribus pariter animalibus vidit, venas nutrientes ad glandulas mesenterii tendere, ibique desinere."—Galen appears not only to quote, but to admit Erasistratus's experiments.—Haller says, "Hæc vasa non tota prætervidit, fatetur certe in hædini mesenterii vasis lac repereri."—Eustachius is supposed by some to have delineated the lacteals in his tables; but I am here of Haller's opinion, who says, that they are not lacteals, but arteries and veins, which are there represented. "Eustachius lactea vasa quidem non depinxit, etsi ita nuper repetitum est. Duplices enim et abruptæ lineæ, quas delineat rubra sunt vasa utriusque generis, inter plicas mesenterii absconsa."—Asellius, however, was the first who discovered them to be a new species of vessels, and who had any just idea of their office. Some anatomists have supposed that there were two species of absorbents on the intestines, viz. lymphatics and lacteals; that the one absorbed lymph, and the other chyle: but there is not the least foundation for such a distinction. The lacteals absorb chyle from the intestines, when chyle is presented to them; and at other times they absorb other fluids. The lacteals also are divided into two sets, viz. deep-seated and superficial. The deep-seated are covered by the muscular coats of the intestines, accompany the arteries and veins, ramify exactly as they do, and are precisely double their number; every artery and vein having an attendant lacteal upon each side, as will be seen in the annexed engraving. The superficial set are immediately under the peritoneal coat of the intestine, and almost always run longitudinally on the gut, afterwards forming nearly a right angle with the portion which turns up towards the mesentery. They may be considered as having the same connection with the deep-seated lacteals, that the cutaneous veins have with the deep-seated ones in the extremities; that is, they may be occasionally traductory canals, and encrease the number of roads by which so important a fluid as the chyle may get into the blood. During the contracted state of the muscular fibres of the intestines, they are, perhaps, the principal conveyors of the chyle and lymph. However closely the deep-seated lacteals accompany the arteries and veins on the intestines, they commonly leave them on the mesentery, and form as it were a number of separate plexus. The manner of their entering and going out of the glands is exactly the same with that which I have formerly described in the absorbents in general; nor are the vasa efferentia so constantly larger than the inferentia as to make any just foundation for the distinction *lactea primi*, and *secundi generis*, &c. of Winslow.

The lacteals of the jejunum are much larger, and more numerous, than those of the ilium, as the valvulæ conniventes, which are wanting in the ilium, encrease the internal surface of the jejunum to two or three times a greater extent than that of the ilium. The surface from whence they arise is not only larger; but, as the chyle, as soon as it is formed, is poured into this intestine, it appears to be the intention of nature, that a greater absorption should take place from this intestine, than from all the others taken together.

The lacteals on the mesentery pass from one gland to another, till they form at last a large trunk, which accompanies the trunk of the superior mesenteric artery till it comes to the right side of the aorta, at the origin of that artery; from whence it passes sometimes almost immediately into the thoracic duct. I have known it more frequently inserted lower than this place; and that, having left the superior mesenteric artery, and run down on the right side of the aorta, it came to the place where the two trunks from the lower extremities were entering the duct, where it also assisted in forming the thoracic duct, as will be more particularly mentioned by and by. Sometimes there are two trunks, sometimes more. Thus they presented themselves also to Haller: "Vasa lactea in majores truncos congeruntur; unicum in hædo, nonnunquam etiam in homine aut duos. Fræquentius aliquot quatorve aut circum eam numerum, etiam numerosa vidi, in femina septem vel octo. Vidi in puero anterius tria, quatorve cum arteria mesenterica secundum dextra orientis jejuni incedentia, plura vero posteriora, minora."

"Tendunt autem cum arteria mesenterica, pone pancreas et duodenum primum, ad sedem dexteriorem, ubi porro cum lymphaticis vasculis conjunguntur, fere in confiniis ultimæ vertebræ dorsi, primæque lumborum."

I have seen the lacteals full of white chyle in the very beginning of the duodenum, and through its whole length. Morgagni saw them in the same state, at the distance of three inches from the pylorus. Haller says, they are by no means few in number: "Et vasa quidem lactea a ventriculo non oriuntur, cæterum a toto intestinorum tractu; a duodeno minime pauca, nasci vidi, in animalibus aliis, in homine." As I had never seen any chyle in the absorbents of the stomach; and as I considered the duodenum, from the opening of the gall duct and pancreatic duct into its cavity, to be a kind of second stomach, even in the human subject, and that the chyle was not properly a nutritious fluid till it had passed through it; I believed that the chyle was never absorbed till it began to enter the jejunum: but it certainly is; and the absorbents of the duodenum are not inferior, in size or in number, to those of an equal portion of the jejunum.

LACTEALS OF THE FŒTUS.

I have occasionally seen the lacteals of the fœtus, but very seldom indeed; they appeared to carry transparent fluids. The chyle perhaps is not then white, though Aristotle asserts that he had seen a white fluid even in the intestines of the fœtus. Had the lacteals of the fœtus been invisible, we must have inferred their existence from the existence of their glands, which are, at three months, perfectly distinct, and scattered along the mesentery.

Werner and Feller say, " Drelincurtius adeo in fœtu sextimestri auditoribus vasa lactea exhibuisse dicitur."

Haller quotes Veslingius, and others who had seen them,—" in fœtu, in homine nuper nato, in infante sex aut octo septimanarum—iidem canales albi,"—and then adds, " Ductum thoracicum et cisternam in fœtu vidi."

Riolan says, in the chapter where he compares the parts of the youngest visible fœtus with the adult body, " Ventriculus mucosa pituita plenus, *quæ non est chylus,*" &c. This fluid in my experiments coagulated with spirits of wine, and is most probably the coagulable lymph secreted by the arteries of the stomach, and may afterwards be converted into chyle.—Milk itself is coagulated by the stomach before it is converted into chyle, as we see in the vomitings of sucking children, and as we find in the stomachs of sucking calves, opened after death.—The meconium found in the child's intestines at three months is light green, the colour of the bile, then, and in the adult often—the peristaltic motion of the intestines Haller saw in the chick on the 14th day after incubation—all this tends to render it probable that the fœtus in utero is in part nourished in the same way as after birth, and that the absorbents are equally necessary in every period of our existence.

THE ABSORBENTS OF THE GREAT INTESTINES.

Those from the cæcum, from the colon of the right side, and transverse arch of the colon, join the trunks of the lacteals, formerly described, at or near the root of the mesentery; these may be called *lactea colica dextra:* whilst those belonging to the sigmoid flexure of the colon, form at last a trunk or trunks, which terminate in the lumbar glands, or having passed their own glands, go immediately into the lower end of the thoracic duct itself. The absorbents of the great intestines seem in proportion smaller than those of the jejunum; and they really are so; but the difference is not so great as at first sight may be supposed. Though we call them great intestines, on account of their larger diameter, yet the jejunum, from the valvulæ conniventes on its internal surface, forms a tube in reality three times longer than it appears; and there is more surface in a foot of it, perhaps, than in the same quantity of the colon. The chief absorption of the chyle being from the jejunum, may make it necessary that its absorbents should be larger than those of the colon. The great intestines, however, are said sometimes also to contain chyle. Winslow demonstrated this to the Academy of Sciences: " On la peut établir en général par les veines lactées des gros intestins: j'en ai démontré plusieurs très-visiblement et très-distinctement à l'Académie Royale des Sciences, dans le colon de l'homme, et toutes pleines de chyle. Feu M. Mery de la même Académie, qui étoit toujours très-difficile sur les observations d'autrui, étant alors présent, et ayant vu qu'avec le bout de mon doigt je poussois uniformément d'espace en espace dans ces vaisseaux du colon la liqueur blanche qu'ils contenoient, en parut d'abord assez content; mais pour s'en assurer davantage, il me fit en même temps, et en sa présence, ouvrir un de ces vaisseaux avec la pointe d'une lancette, en tirer un goutte de la liqueur, et la mettre sur l'ongle de mon pouce; ce qui le contenta entierement." Haller also asserts this.—I have never seen it.

I by no means assert, that the absorbents of the great intestines do not absorb something from their contents, as well as those of the small intestines; though I have seen solid fæces in the beginning of the colon. The fæces are, however, certainly harder in the rectum than in any other part of the great intestine, and particularly so in costive habits of body, where they have remained for a long time; but the fæces could not become more solid any other way than by an absorption of the thinner part. Copious and nutritious glysters have been given by the rectum, which never have returned in that form. Though I have said, that I knew of no case where patients had been nourished by glysters longer than three weeks, there are cases on record of their having supported the body for forty days, or even three months. Glysters of turpentine give the urine the smell of violets; and the Peruvian bark has cured fever, exhibited in the form of glyster, when the stomach would not retain it. " Vis corticis Peruviani, quam credas in terra esse, tamen per glysteres ad sanguinem penetrat, febresque tollit, eoque eventu Andrianus Helvetius plurimos imprimos pueros sanavit." Haller.—The Peruvian bark may, however, cure the fever without being absorbed.

Though very little chyle may be absorbed from the great intestines, the absorbents are necessary to remove the fluids of surfaces and cells. The solid parts of these intestines are also sometimes removed; and, besides these purposes, as I have just now observed, the absorbents here are intended occasionally to take up nutritious fluids, or even medicines themselves thrown into these cavities, in situations where they could not be applied to the usual surfaces.

THE THORACIC DUCT.

Having pointed out the principal vessels, by the union of which the thoracic duct is formed at its beginning, I shall take an opportunity here of describing more particularly this principal trunk of the absorbent system; after which I shall return to the description of the other vessels which enter it, through its course along the spine, toward the left subclavian vein. I must take notice also of a second, but shorter and inferior trunk, which terminates in the right subclavian vein.

The name thoracic duct, first used by Tho. Bartholin, appears to be extremely improper, as it lies as much in the abdomen as it does in the thorax, and by no means conveys the idea of the principal trunk of the absorbent system. The name of ductus chylifer, given it by Albinus, is equally improper, since it carries as much, or perhaps more, lymph than chyle, and many other fluids besides. Boerhaave compared it with the cava inferior; in which respect it might be considered as a cava minor. There is also some analogy between the second trunk of the absorbents and the cava superior.

The first discoverers of the thoracic duct described it as beginning by a pyriform bag, to which they gave the name of the receptacle, or the cistern of the chyle. In quadrupeds, particularly in dogs, it actually arises out of a large cavity, in which the lacteals terminate, and pour out the chyle. "In brutis animalibus plerisque chyli cisterna reperitur, ut in cane, in quo primum est inventa; in lupo, leone, urso, phoca, sue, erinaceo, bove, capella, cervo, equo." In these animals, "Ampulla chylifer insignis sedet, multo omni ductus thoracici diametro latior, ovalis et longior, in quam confluunt, hæc, quæ diximus, vasa lactea super venam renalem, et ductus lymphatici magni lumbales et hepatici." Haller.—This description by no means agrees with what we commonly find in the human thoracic duct. I do not say that a receptacle of the chyle never exists in the human body. I have seen it sometimes; but much more frequently there is none. Haller says, "Neque in hominem nunquam ea fabrica reperitur; etsi nuperiores scriptores cisternam solent exagitare. Sexies certe inter 21 cadavera humana, in quibus ductum thoracicum ostendi, ampullam vidi." At any rate, the name of receptacle of the chyle is improper, as it conveys an idea that the thoracic duct received nothing else than chyle; which its first discoverers, as they knew nothing of the lymphatics, really believed was the case; but as we now know that this trunk of the system receives the lymph pretty constantly, and the chyle only at certain periods, and as the lacteals are seldom inserted into the receptacle, even when it is found, I shall avoid the term.

The thoracic duct begins much lower down than has commonly been imagined, and is situated at first on the third vertebra of the loins, on the left side of the spine, instead of on the first vertebra of the loins, and on the right side of the spine, as has been asserted. I have commonly injected it from the glands of the groin, on both sides, and by this means have seen its origin more distinctly. Haller's method was by no means so proper. He says, "Si solum ductum thoracicum demonstrare volueris res nullius est difficultatis—Inquires enim vel in vas lymphaticum aliquod ante sinistram venam renalem adrepens qualia nunquam non adsunt, vel in vas lumbale ad latus aortæ sub renali dextra arteria et vena latens." We have no opportunity, as in quadrupeds, of making ligatures in the living body, on the upper end of the thoracic duct, and seeing it fill itself with chyle.

The thoracic duct begins by the union of three trunks, as I formerly observed; one of these is the trunk of the absorbents of the right leg, the second is the trunk of the absorbents of the left leg, and the third is very commonly the trunk of the lacteals; these, by their union, sometimes form a globular cavity, half an inch in diameter, lying on the second vertebra of the loins. At other times, the three trunks lie parallel to each other for an inch or two, before they unite; during which period they are wrapt up in the same covering of the cellular membrane; and, when cut across, without dissection, have put on the appearance described by some, " Cavitatem veram trilocularem." After they unite, the duct becomes smaller. During this course it is under the aorta, and crosses obliquely from the left to the right side of the lumbar vertebræ, where it enlarges again, and sometimes forms a pyriform bag, on the uppermost vertebra of the loins, which has commonly been said to be the beginning of the duct.

Haller's description is somewhat different from mine: " Oritur in meis experimentis ex trunco lymphaticorum lumbalium, incipit intumescere ad arteriæ spermaticæ initium tenet angulum inter vertebram primam lumborum et appendicem diaphragmatis intimam ad dextra arteriæ aortæ et pone omnia vasa renalia a secunda vertebra lumborum ad primam dorsi."

At the uppermost vertebra of the loins, the thoracic duct lies under the right crus of the diaphragm. Haller supposes, that this muscle, in contracting, comes nearer the bodies of the vertebræ; and therefore, in every contraction, compresses the receptaculum chyli, and in every relaxation leaves it free: that in the one state the chyle must be drove on, and in the other state the chyle has room to enter. This he compares to the systole and diastole of the heart: " Dum inspiramus, tumere appendicem diaphragmatis, quæ cisternam protegit, eamque excutere et inanire, uti œsophagum comprimit; sic motum in chylo orire:"—and, to reverse his expression, afterwards, " Erit tempus *systoles* ejus ductus." On the contrary, when the diaphragm relaxes, and its crura become flaccid, the receptacle of the chyle will be filled, as the trunks of the lacteals will then throw their fluid into a cavity where they meet with the least resistance. This state of the diaphragm he compares with the diastole of the heart: " In expiratione—remittit se diaphragma et ejus appendices detumescunt. Replebitur adeo cisterna a chylo, quem vasa lactea eo, tamquam in locum minus resistentem, submittunt, erit *diastole* cisternæ." He supposes a similar effect from the alternate states of compression and relaxation, which the contents of the thorax undergo in respiration: " Nunc certum est, per numerosissima experimenta, alterne in toto thorace pressionem minui, laxari omnia, inque amplius subnatum spatium se liberius diffundere, ut etiam expulsi pulmones in pectus quasi resorbeantur; et vicissim in expirationem comprimi, etiam vehementer, atque totam pulmonem de vulnere expelli."

I believe that the crura of the diaphragm have very little contraction or relaxation, except on extraordinary occasions, as in sighing, yawning, coughing, and straining of every kind; for on those occasions I have frequently found them, in my own body, pulling the centrum tendinosum downwards, disturbing the motion of the heart, and giving pain in that region; and I should rather suspect that, on these occasions, they receded from the body of the first vertebra of the loins, than that they came nearer to it; but I am not certain. Haller himself, in another part, makes all this extremely doubtful; for he says, "Etsi enim pressionem musculorum abdominis aliquid in plenissimo abdomine possit, in cisternam potissimum tamen experimenta docent, chylum iis musculis resectis, a morte celeriter moveri." The fluids also continue to flow through the thoracic duct, after the thorax is opened, and when every effect of alternate compression and relaxation must of course have been removed.

About the first vertebra of the loins, the thoracic duct getting above the diaphragm, lies on the right side of the anterior surface of the spine, between the vena azygos of the right side, and the aorta of the left, and thus as high as the upper edge of the arch of the aorta. If it be double, one of the ducts lies under the aorta commonly; and even when it is not double, very large vessels belonging to it lie under the aorta, and must receive its pulse in its diastole. It has been supposed probable, that as in the greater part of its course through the thorax, though the thoracic duct does not lie under the aorta, yet, as it lies upon its right side, the fluids of the one may receive some impetus from the distension of the other. Haller attributes much of the motion of absorbed fluids to this pulse of the aorta; so that he even thinks it probable, that the reason why the thoracic duct, which below the arch of the aorta lay upon the right side of the spine, and of course nearer the right subclavian vein, crosses under the arch of the aorta, and passes to the left side, to terminate in the left subclavian vein, is, that its fluids may receive a stronger momentum from the dilated arch of the aorta, where the force of the blood is stronger than any where else. This he thinks is farther confirmed from this circumstance, that where the viscera have been transposed, and the aorta has gone down on the right side of the spine, instead of the left, and the thoracic duct, also transposed, lay upon its left side, it still crossed under the arch of the aorta, and was then inserted into the right subclavian vein. "Suspiceris, ut eam pressionem potentiorem experiatur, ad sinistram axillarem venam, pone aortæ arcum chyliferum ductum traduci, qui propior fuisset dextræ subclaviæ: adeo certe constante naturæ fine, ut cum omnia viscera transpositi forent, is ductus in dextram pariter subclaviam insereretur."—The pulse of the aorta may be a powerful assistant in driving on the absorbed fluids through the thoracic duct, and the pulse of arteries in general may be of the same utility to its branches, in propelling their fluids; but the principal force propelling the absorbed fluids, is to be attributed to the muscular powers of the absorbent vessels themselves. For the absorbents very often forsake the arteries, and go by themselves, as we see on the mesenteries of quadrupeds, and in their accompanying the cutaneous veins in animals in general, from which they can receive no propelling impulse. One reason why the thoracic duct goes to be inserted into the left subclavian, in preference to the right, I have already given, viz. that its fluids might receive less resistance from the stagnation, or even retrograde motion, of the blood in the cava superior and its great branches, that take place on the contraction of the right auricle. The angle of the right subclavian, or, properly speaking, the right jugular vein, is in a direct line with the cava superior, whilst the left jugular is at right angles with the subclavian, and this last forms an obtuse angle with the cava superior; and therefore the resistance in the right side is greater, to the entrance of the absorbed fluids, than in the left.—But I return to the description of the thoracic duct.—Having emerged above the diaphragm, it gradually becomes smaller, until it comes near the middle of the back, where it is frequently not much more than a line in diameter; after this, it gradually enlarges, and near its termination may be about three lines in diameter: I have said that it was frequently five lines in diameter at its origin. Once I saw it as large as a goose-quill, through its whole length; and this winter my assistant, Mr. Wilson, injected it, when it took two pounds of quicksilver to fill it, and was in most parts, half an inch in diameter. When injected through its whole length, it appears to run serpentine; in this last mentioned instance it was amazingly serpentine, but this may sometimes be a deception: arteries that were formerly straight, become serpentine on being very much distended, as we see in the arteries on the outside of the head, in old men, which being nearer the heart, in proportion, than most other arteries, are more dilated, and more serpentine. We see the same thing also in the collateral anastomising branches of the brachial artery, round the joint of the fore-arm, and arm, after the operation for the false aneurism, from bleeding at that place, has been performed; these arteries in general are straight; but, after the operation for the aneurism, become exceedingly serpentine. The thoracic duct, however, without being injected, is somewhat serpentine. Haller says, "Per thoracem adscendit, paulum serpentinus, tamen ut pene rectus adscendat."

In the incurvations of the spine, the thoracic duct, as tied to it by its branches, by those of the azygos, and by cellular membrane, must make the same windings and angles that the spine happens to make; and as fluids, if the projectile force is the same, will move with greater velocity through a straight than a curved tube, the force with which the absorbed fluids of the thoracic duct overcome the resistance to their entrance into the veins, made by the blood in them, must be diminished in such bodies; but whether this diminution of force is attended with any material bad consequence, I do not know. I have seen a trunk of the absorbents of the lungs convoluted at least a thousand times before it entered the duct *, and I have seen similar convolutions in parts of the duct itself. A great deal of power appears to be lost, by the construction of animals, in many of their parts; but this loss appears not to be attended to, when an adequate advantage is procured in some other way.

During its course along the vertebræ of the thorax it has the aorta on its left side, and the vena azygos on its right, and is besides surrounded with numberless ramifications of the *intercostal* and *par vagum*, particularly the former; this last circumstance by some is supposed merely accidental. Professor Walter says, in his elegant publication on the Intercostal Nerves, "Convictus sum ductum thoracicum nullos habere nervos." Not that they do not lie on its surface, and surround it, we know the contrary, but that they do not enter its substance. From his amazing accuracy it is impossible to doubt the author; but as the nerves are very frequently forming rings and net-work round the trunks of arteries, without appearing to be inserted into them, while at the same time we have the strongest proofs of these arteries being influenced by the mind, as in blushing, anger, the erection of the penis, clytoris, and nipples. As we find the only power the mind has over muscles, is by means of the nerves, so we conclude that when arteries are thus affected, it must be through the same medium. If arteries are affected by the mere contact of their own nerves, which may be the case for any thing we know, though muscles are not, so may the thoracic duct.—As nerves, however, in order to influence muscles, must be inserted into them, so we should naturally presume, that in order to influence arteries they should also be inserted into them. Professor Walter says, they actually are inserted into the muscular coats of arteries, his terms are, " Surculi qui in tunica musculari aortæ implantantur—Surculus qui in tunica musculari aortæ consumitur—Nervus qui arteriæ implantatur;"—but as he denies such terminations in the thoracic duct, and as I have never seen any such, so I have no doubt of the absorbent system being less dependant on the nerves, than the muscles or arteries: yet, as the mode and extent of nervous influence is not known, so I contend that the non-insertion of the nerves into the thoracic duct, is no proof that they have no influence over it; besides, the nerves entering the coats of the thoracic duct, may be too small to be capable of being shewn by dissection. The nerves going to the teeth in the adult human body, have never yet been shewn by dissection; indeed, the hole through which the arteries enter, the veins and lymphatics return, and which is lined also by the internal periosteum, which besides must transmit these nerves, is little more than visible to the naked eye; how is it possible then, that the nerves should be singled out, by dissection, from these accompanying vessels and periosteum? yet the great sensibility of the teeth to heat, cold, and contact of hard and soft bodies, in health, as well as their intense feeling of pain in the tooth-ach, the dividing and burning the packet of vessels entering the teeth destroying this tooth-ach, demonstrate sufficiently their existence, in spite of anatomical dissection.

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* Vid. Plat. IV. a. b. c.

About the sixth or seventh, or more frequently the eighth, vertebra of the back, the thoracic duct splits into two, and then unites again; this is what Haller calls *insulam faciens*; sometimes it splits into several branches, which again unite, as in the former example; sometimes it forms a number of these islands, and sometimes it forms none. Having passed the arch of the aorta, the thoracic duct crosses, as I have said, from the right side of the spine to the left, and when full, or injected with a coloured fluid, may be seen on the left of the œsophagus distinctly through the pleura, without any other dissection than that of opening the chest, and turning forward the lungs. After this, the thoracic duct, emerging from the cavity of the chest, gets above the pleura, and lies upon the muscle longus colli, and behind the arteria thyroidea inferior; at this place it enlarges considerably, and though its destination is the angle of the subclavian and jugular veins, it passes by that angle, forms a considerable curve, and descends to its termination, I formerly supposed, with a view to give its fluids the advantage of their own gravity in overcoming the resistance made to their entering the veins; but it is much more probable that this curve is formed to give room for the insertion of a number of large trunks, which join it just before its entrance into the veins. It sometimes, though rarely, happens, that the thoracic duct does not pass by the angle of the jugular and subclavian, but ascends to its termination. Haller says, " In venam suam ascenderit neque surgerit, supra subclavios truncos—id semel puto in homine vidi aut bis, vidit etiam accuratissimus Cassebohmius." Before its insertion, and whilst it is behind the jugular vein, it commonly splits into two, three, or more branches; these, for the most part, unite again, and the duct terminates in the veins as a single trunk: sometimes they form two or three separate terminations; these terminations are sometimes in the jugular vein above the angle, more commonly in the subclavian vein, on the left side of the angle. Haller says, " Rarum enim, si ductus thoracicus in sinistram subclaviam, quidem sed multifidus et plusquam duobis ramis, tribusve, et pluribus, sui finem fecit, vidi tamen et in homine." In the human subject there are constantly a pair of valves at the entrance of the thoracic duct into the subclavian vein; these, on certain occasions, shut up the duct, and prevent the venous blood from flowing into it. Haller, speaking of this valve, says, " Officium valvulæ habere clarissimi viri censent, ut chylum in venam admittat

mittat in ductum nequaquam. Ad id munus mihi vix sufficere videtur." He says also, of the other valves of this duct, " Raræ tamen sunt in homine, ut exstent, qui negant earum numerum superare duodecim, parumque conspicuæ, ut etiam officio suo non valde accurate fungantur, nec totum lumen ductus thoracici claudant, chylumque relabi ceramque retrorsum descendere permittant." For my own part, I know no other use they can serve, than that of preventing the retrograde motion of the chyle, or hindering the blood in the veins from passing down the duct. The valves allowing injection to escape in the dead body, proves nothing, as many circumstances are wanting which existed in the living body; however, in the dead body, so well do the valves at the orifice of the thoracic duct perform their function, that it is exceeding rare indeed to find the injection passing from the vein into the thoracic duct, I do not recollect its ever happening to me when the injection was viscid. I admit that the valves can be of no use, except on certain occasions; and that, as the fluids in the thoracic duct are generally able to overcome the resistance of the venous blood to their entrance into the veins, this alone prevents the blood from passing into the duct, and the valves are not called into action: but there are two occasions in which I have no doubt that these valves are wanted:—The first is, in straining and coughing, and other violent efforts, the blood of the subclavian and jugular veins is prevented from passing into the heart, of course distends the sides of those vessels with uncommon force, such as the absorbed fluids would not be capable of overcoming; the venous blood would then descend into the thoracic duct, did not these valves prevent it: the motion of the chyle would also, at that time, become retrograde, did not the other valves prevent this. There is also another occasion on which it appears to me more than probable that the valves are called into action:—Doctor Hunter suspected that the chyle went into the blood, at the angles between the jugulars and subclavians, drop by drop, and that it was constantly doing so. From what I have seen, in opening living or recently dead animals, I am persuaded that it must be otherwise: for there are only particular periods when the chyle is poured into the intestines, at which periods only it can be absorbed. I have also seen very large quantities of chyle in the subclavians, vena cava superior, and right auricle of the heart, floating as it were upon the surface of the blood, and perfectly white; at other times the mixture of red and white was so uniform, that there must have been at least as much chyle in these cavities as there was blood. From these facts it must follow, that the chyle is poured into the veins in full stream, and that there are periods when the absorbed fluids are thrown into the veins in greater quantity, and with greater force. I even doubt if the exhaled fluid of surfaces and cells be in sufficient quantity, that by its constant absorption it should be able to keep the absorbents in full employment, and always distended. I am even certain, that the absorbing powers are frequently less active; and that, upon all these occasions, the valves will be brought into action, to prevent the blood of the veins from passing into the duct.

The thoracic duct is sometimes double through its whole length: there is a preparation of this kind in the collection in Windmill-street, which I injected many years ago with quicksilver; one of these thoracic ducts is inserted into the right subclavian vein, and the other into the left. I have also sometimes seen it triple, or nearly so. Sometimes the thoracic duct is inserted into the right subclavian vein, instead of the left, and then the trunk of the absorbents of the left side, in every respect resembles the ordinary appearance of that of the right side. There is also a preparation of this kind in the collection at Windmill-street, which I injected from the umbilical vein in a child at birth; the injection was melted tallow, softened with some turpentine, and coloured with vermilion: the injection got into the thoracic duct, which was distended with a white injection through its whole length, and was inserted into the right subclavian; the colour had been dropt by the way, as we have frequently seen it when a similar injection has passed from the extremities of arteries into the beginning of veins, and which is a proof of its having passed through extremely fine tubes.* The same thing I find had happened to Haller and Mekel. Haller says, "Ductus thoracicus per arterias aliquando se repleri passus est oleo potissimum terebinthinæ rubro. Solet vero id oleum colorem deponere." I suspect here, that the injection passed into the mouths of the lymphatic vasa vasorum, which arise from the internal surfaces of the arteries and veins.

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* This I have seen when the injection passed from the arteries of the pia mater into its veins, where, though red at first, it returned white by the veins. In the arms, however, I have often known it return by the veins on the points of the finger unchanged.

It has sometimes happened that I have injected the branches of the thoracic duct from the trunk, contrary to the valves, so as almost to shew the spine covered with lymphatics, and to inject those of the intercostal spaces themselves; so that our common injections of that duct, which do not pass the valves, give no adequate idea of this trunk of the absorbent system, as they represent it without any branches.

THE TRUNK OF THE ABSORBENTS OF THE RIGHT SIDE.

Having described the thoracic duct, or the principal trunk of the absorbents, which is inserted into the angle of the left jugular and subclavian veins, I come next to describe the other trunk, which is inserted into the angle formed by the same veins on the right side. The length of the thoracic duct is from sixteen to eighteen or twenty inches, for this varies in proportion to the height of the body. Its diameter, just before it terminates, I have said, is from two to three lines. The trunk of the absorbents of the right side is commonly not more than a quarter or half an inch in length; and its diameter, near its termination, very nearly the same with that of the thoracic duct at the same place. It belongs to the absorbents of the right lobe of the liver, right side of the diaphragm, right side of the heart, right lobe of the lungs, right arm, right side of the head, and right lobe of the thyroide gland. When the thoracic duct happens to be inserted in the right subclavian vein, the trunk in the left side, in every respect, resembles that of the right, as I have already said. The termination of lymphatics in the right subclavian vein, appears to me to be the discovery of Steno, the pupil of Thomas Bartholin. It was made in quadrupeds, but it was very easy to transfer it to the human subject. Haller says, " Ita Nicolaus Steno ex dextro capitis latere, dextro pede * anteriori et dextra pectoris cavea, vasa lymphatica in venas axillares deduxit." Ruysch also asserts, that the lymphatic vessels of the lungs terminated in the subclavian veins. Haller says, " In pectore vasa lymphatica pulmonis in venas

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* Brachio forsan.

nas subclavias et axillares ire, non facile in mera rerum historia rejiciendus auctor testatur Fredericus Ruysch."—Another part of this termination was also discovered by Nuck.—The same author says, " A spatiis intercostalibus venas pellucidas in jugulares truncos derivavit Nuckius, tum a diaphragmate in easdem venas, a corde iterum in eas, et in subclavias." Mr. Hewson, however, appears to have been the first who distinctly made out this trunk; for these other anatomists, though they knew the termination in the right subclavian vein, constantly described them as numerous, not forming a common trunk. Though Haller quotes Mr. Hewson, respecting these terminations, he does not say whether he made it a single termination, or a number of terminations. He says, " Numerosa etiam vasa aquosa, sunt thyreoideæ glandulæ. Hæc omnia in trunculos unita, cum ramis a capite descendentibus et comitibus ramorum arteriæ carotidis, demum in dextro latere cum vasis pulmonis et thyreoideæ, dextra quidem in angulum venæ subclaviæ cum jugulari, sinistra vero et in ductum thoracicum se immittunt, et in subclaviam, iterum Hewsono auctore."—Mr. Hewson's words are, " The lymphatic vessels of the right side form four considerable trunks, which join near their termination. These trunks are, first, one from the upper extremity; secondly, the trunk of the lymphatic vessels of the right side of the head and neck; thirdly, a lymphatic from the thyroide gland; fourthly, the trunk of the lymphatics from the fore part of the lungs of the right side." He has here omitted the lymphatics from the right side of the heart, as well as those from the liver and diaphragm, and the vessels accompanying the internal mammary arteries, which he certainly had not seen. Indeed it frequently happens, that there are more insertions than one in both subclavian veins; and, though the insertions into the angles between these and the jugulars appear to be the most accurate, yet it does not seem to be of that consequence as not to admit of some little deviation; accordingly, we find insertions sometimes in the jugulars, a little above the angles, sometimes in the subclavians, a little to the outside of the angles.

We return now to the cavity of the abdomen.

THE ABSORBENTS OF THE OMENTUM.

These are in three divisions, like its arteries and veins; and the larger trunks are found with the arteries epiploica dextra, epiploica media, and epiploica sinistra. They commonly pass into glands between the superior edge of the omentum and the inferior edge of the stomach. Having passed through these glands, they blend with the absorbents of the stomach. These glands are not always found, and when they are found, are commonly very small. Haller has noticed these glands, but seems to have known very little of the absorbents. " Glandulas, in nullo omentorum vidi, præter eas quæ arcum majorem ventriculi sequuntur, et quæ minorem; easque quæ ad portas hepatis adsident; sed eæ ad omenta pertinent. —Lymphatica vasa, qui ipsi forte Biumi sunt canaliculi, possunt circa glandulas conglobatas fuisse."

THE ABSORBENTS OF THE STOMACH.

I formerly mentioned a passage in Hippocrates, where it is said, *Εισι απο της κοιλης φλεϐες—δἰ ὧν ἡ τροφη εν τω σωματι ερχεται.*—" There are veins which come from the stomach, by whose means the food comes into the body." I then said those veins were imaginary, that the lymphatics of the human stomach were not easily found, and that they never carried a white fluid, like the lacteals. In opposition to this assertion of mine, I find a treatise by Biumi, an Italian anatomist, published at Milan in 1728, entitled, " Esamine d'alcuni canaletti chiliferi chi del fondo del ventriculo per le tonache dell' omento sembrano penetrar nel Fegato."—That is, "An examination of certain vessels carrying chyle from the cavity of the stomach, which, passing along the coats of the omentum, appear to penetrate into the liver." I have not seen the book; but I understand from Haller, that this pretended discovery was made in dogs; that the trunk of those vessels was as large as a goose-quill, and that it divided into smaller branches, which ramified through the liver; that when opened, the chyle flowed out; that the author asserted, it was by means of those vessels that medicines got by a shorter road into the blood, and the food itself, in strictures of the pylorus, when it could not possibly get into the intestines. "Vasa chylifera fuisse, dissectis chylum dimisisse, et candore suo conspicua fuisse, ea esse vascula quæ brevi via, aquæ acidulæ, ad sanguinem veniant; et ob eam causam supervivere, quibus ob clausum ventriculi exitum, nihil ad intestina, neque ad vulgata vascula lactea venit." Haller also says, "Deinde Broggius et Bellus viderant vasa alba in animalibus de tota ventriculi longitudine orta, conjuncta in truncum, valvulosum, tendentem ad hepar, per id viscus distributum, a lymphaticis vasis diversum, solum vehentem chylum." I should hardly have noticed these experiments, if Haller had not shewn some disposition to believe them. His comment, in his Bibliotheca Anatomica, on them, is, "Experimenta nimis pauca." Some of the lacteals anastomose with the lymphatics of the liver and diaphragm, as I have already shewn; and it is equally possible, if the absorbents of the great intestines transmit chyle, that some of those belonging to the transverse arch of the colon may anastomose with the absorbents of the stomach, and that the chyle might thus be seen in them, and might take the road they have described. But I never saw this; even when I have seen the chyle in the lacteals of the duodenum, I never saw any on the pylorus, or any part of the stomach. The sudden restoration of vigour, in languors and want of food, that takes place on throwing nourishing fluids or solids into the stomach, depends on another circumstance. The watery part of the food may be absorbed from the stomach, and thrown off by the kidnies; but it is the chyle only which nourishes. Now it requires some hours before the chyle is formed; and it is not perfect till it has received the bile and pancreatic juice in the duodenum, after it has quitted the stomach, as we see from the derangement and debility which take place when any cause prevents the union of these fluids with the chyle in the duodenum. The restoration of vigour is certainly from the effect, these stimulating, as well as nutritious substances, thrown into the stomach, have on its nerves, and muscular fibres; and one might as well contend, that when spirit of sal ammoniac was held to the nose, and recovered a person from a fainting fit, or prevented one, that something was absorbed from it and carried into the blood. It is not true. It produces its effects instantly, and only in proportion to its strength, and great stimulus on the extremities of nerves immediately almost connected with the brain, and which are less covered than any other nerves in the body. Haller does not admit those chyliferous vessels of the stomach, only because they have not been seen by later anatomists. "Verum alba quidem in ventriculo vasa nuperior industria non reperit, neque admiserunt viri in vivis animalibus incidendis plurimum experti." Amongst those he mentions Bruner and Pauli. I have admitted the possibility of the appearance, though I have never seen any thing like it myself; and have endeavoured to account for it in a different way. Veslingius had before this described lacteals on the stomach, "Vasa lactea in ventriculo," but the anatomists, at that period, called every vessel that resembled lacteals in the transparency of their coats and number of valves, lacteals. Veslingius says, sometimes, "Lacteorum æmulos vidi." Though I have not seen chyle in the absorbents of the stomach,* I have often seen the lymph, and very often injected those vessels, not only in the human subject, but in a variety of animals; in an elephant, in horses, in asses, in the turtle, and in skate. In the turtle I have pushed the injection to the internal surface of the stomach, and seen it in vessels just visible to the naked eye.

The absorbents of the stomach form three principal divisions; one set accompany the branches of the coronary artery and vein, they run from the anterior and posterior surfaces of the stomach towards the small arch, and I have usually distinguished them by the name of *coronaria ventriculi.* They also are double the number of the arteries and veins, and run, like the lacteals, on their outsides, having an artery and vein between them; they also consist of a deep-seated and superficial set; they run towards four, five, or six glands, sometimes situated on the small arch of the stomach itself, sometimes between it and the little epiploon of Winslow. Having entered these glands, they pass out in larger trunks, which commonly pass into the same glands, behind the duodenum, which the deep-seated absorbents of the liver enter, and with them pass into the thoracic duct, on the right side of the aorta, near the origin of the cæliac artery. Sometimes I have seen them run upwards, towards the cardia, and pass into the thoracic duct behind it. A preparation of this kind I had many years ago in Windmill-street. I removed the stomach, with a part of the thoracic duct behind it, and put it in spirits. The absorbents were seen running from the small arch into the thoracic duct, which was turgid with the quicksilver it had received from them. Haller appears to have seen these vessels: he says, "Cum in superiori arcu ventriculi et in majori glandulæ conglobatæ sint, in ventriculo etiam vasa lymphatica merito exspectes, in arcu certe minori vidi quam maxima tendentia in ductum thoracicum." The next division, is that from the middle of the great curvature of the stomach; it is joined by the absorbents epiploica media and sinistra of the omentum; and, running with the artery named gastrica sinistra, passes upwards, and to the left, towards the great end of the stomach, where it blends with the absorbents of the spleen and pancreas, and goes with them into the thoracic duct. They may be termed *gastrica sinistra*. The third division arises also about the middle of the great curvature of the stomach, runs with the artery named gastrica dextra, towards the pylorus, receives in its way the absorbents epiploica dextra of the omentum, and, blending also with the deep-seated absorbents of the liver, behind the duodenum, enters the same glands, and passes with them into the thoracic duct. Haller appears to have seen these only in the quadruped, for he says, "Et ego in cane vasa lymphatica ab omento in ventriculum venientia vidi, qua sede eorum erant trunculi." These may be named *gastrica dextra*.

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* In one instance I saw a white fluid in the lymphatics of the stomach, the woman died suddenly of an apoplexy; the lacteals of the intestines then also contained chyle.

Of the inorganic pores of some anatomists, supposed to exist in the stomach, I know nothing, and believe as little. By those they mean pores penetrating its solid substance, but not belonging to any vessels. "Non hic poros volumus qui in venas ex ventriculi cavea pateant, sed poros qui per ipsam naturam solidam partium ventriculi faciant sibi viam." By these pores they endeavoured to explain the quick return, by urine, of mineral waters, when taken into the stomach; the sometimes sudden cure of dropsy of the abdomen, by vomiting or purging. Haller here seems to doubt; and even furnishes me with arguments against himself, in another part of his work, having first said, that it might be so. "Mihi res videtur simplicissima. Cutis ipsa absque illa de truncis resectis suspicione, et corium, nisi crassissimum

simum fuerit, aquam et potissimum calidam transmittet. Et bilis manifesto per vias non vasculosas in exteriorem faciem vesiculæ penetrat. Utique ergo ut in aliis corporibus, ita in nervea ventriculi et in peritonæo, pori sunt inorganici quos aqua penetrare idonea est." I have already proved that there is no such transudation in the living body; and Haller, notwithstanding the foregoing sentences, furnishes me with additional proofs. The bladder will burst, in suppression of urine, if an operation is not performed, or the cause removed: when the chyle cannot pass the pylorus, the stomach is enlarged to an immense size; and blue solution thrown into the stomach of a living dog, appeared in the lymphatics, but not in the cavity of the abdomen. "Num ideo in vivo animale humor per eos poros vere penetret, possit dubitari. Ostenditur vesicam urinariam plenissimam repertam esse absque ulla lotii in abdomine effusione, cum exitus urinæ per ureterem interceptus esset. Ventriculus, ob clausum pylorum cibis et potui impervius, extenditur in immensam molem indicio potum non adeo facilem viam reperire per quam effugiat, in aquam hydropicam potus se non admiscet quæ coagulabilis sit indolis quale nihil bibimus, et in sano homine etsi plurimum bibit præter vaporem nihil est in abdomine. Cum cæruleo pigmento ventriculum vivi canis replerem, tinxit vasa lactea; cæterum in abdomine is color non exiit, neque se ut fuerat necesse suo colore extulit."

OF THE ABSORBENTS OF THE SPLEEN.

These are of two sets, a deep-seated and superficial. The last run upon the surface of the organ, between the peritoneum and its proper coat; these are with great difficulty seen in the human subject, but, in quadrupeds, particularly in calves, are more numerous than perhaps on the surface of any viscus in any other animal. In the human subject, they run on the convex side of the spleen, towards the concave edge, where its arteries are entering in; they there join the deep-seated set. These last, as in the kidney, accompany the veins through the substance of the spleen: they are easily shewn, by making ligatures on the splenic artery and vein as they come out of the spleen, and gently kneading its tender substance between the thumb and fingers: the blood, which had transuded into the cellular membrane, is thus forced into the absorbents, and they become visible. Haller says, " Sic olim F. Ruyschius, ligata vena lienali, et contrectato viscere, vasa lymphatica demonstrabat." The absorbents of the spleen, soon after they emerge from its substance, pass into glands which lie upon the splenic artery, and which are scattered at little distances from one another through the whole course of that vessel. In their course through these glands they receive the absorbents of the pancreas, and, having blended with those from the stomach, and some from the liver, near the head of the pancreas, they pass with them into the thoracic duct.—Haller does not say that he has seen these himself, but, quoting Malpighi, says, " Secundum totam arteriam splenicam, ad sinum usque lienis glandulæ conglobatæ abundant, quas adeunt."—Again, " In homine rara est memoria; subinde unum alterumve se vidisse in posthumis Cassebohmius, pauciora esse Ruyschius fatetur, et Nuckius, et Winslow."—At the time the first edition of this work was in the press, I had an opportunity of seeing them larger, and in greater numbers, than on any former occasion.

THE ABSORBENTS OF THE PANCREAS.

Haller says, he does not know whether the pancreas has lymphatics or not. The anatomists who succeeded Asellius speak of them frequently. " But then," he says, " it is not the true pancreas which they mean, but the spurious one of Asellius, or the conglomeration of the lymphatic glands, at the root of the mesentery, in dogs." His words are, " Num pancreas lymphatica vasa habeat? ignoro, et dubito. Quæ adeo frequenter apud seculi prioris scriptores nominantur, ea fere ad spurium illud Asellii pancreas pertinent."—Asellius mentions the true pancreas as glandula ignota; and Mr. Hewson says, " The lymphatic vessels of the spleen pass from the concave side of that viscus, along with the splenic artery, in the sinuosity of the pancreas, by the lymphatic vessels of which they probably are joined."

That the pancreas had absorbents, I never doubted. I have seen them, on a great many occasions, rising out of the pancreas, and joining the splenic plexus, already described. They seem to have been first discovered by Veslingius; and he expresses himself in such a manner, that there can be no doubt of his meaning the true pancreas.—Haller quotes the very passage in one part of his works, though he seems to have forgot it here. He says, "Johannes Veslingius die 18 Januarii, 1649, lactea vasa vidit, qua parte pancreas lieni cohæret, et qua parte ventriculus lieni incumbit." His calling them lacteals, does not in the least invalidate the fact; the lacteals and lymphatics had not then been separated; it was done afterwards by Rudbeck and Bartholin.

I injected them, in 1773, from the absorbents of the liver, contrary to the course of the valves, the whole length of the pancreas; they arise out of its substance, on its superior edge, sometimes at right angles to the principal trunk of the splenic plexus, which runs on the coats of the splenic artery; they have no centre of ramification, but come out from the lobes in short branches like their arteries and veins.

THE ABSORBENTS OF THE LIVER.

There is no part of the human body in which I have been more successful in discovering the lymphatic vessels than in the liver; and I have still a manuscript in my possession, in which they were described, at the desire of Dr. Hunter, in March 1773.—The absorbents here divide themselves into two sets, those which run upon the surface of the liver, and the deep-seated, which accompany the vena portarum. The absorbents on the superior surface of the liver arise in four divisions; there is, however, considerable variety here, and I have occasionally seen six, eight, or ten divisions; I shall describe, however, the more common appearance.—The principal division commonly appears on the superior surface of the great lobe of the liver (I am here considering the body as lying upon its back), on the right side of the ligamentum suspensorium hepatis. It consists commonly of a number of parallel trunks, which are sometimes more evident on the ligament itself than on the liver. One of these trunks, however, is larger than the rest, and receives the smaller absorbents, as the trunk of a tree would receive branches; these are joined commonly by another plexus from the superior surface of the left lobe of the liver, and which run on the side of the suspensory ligament opposite to the former. From each plexus, I have injected the deep-seated absorbents, by vessels which went off from them, and entered the substance of the liver through the hole by which the remains of the umbilical vein of the fœtus passes in the adult. At other times, I not only injected these vessels, and the deep-seated vessels passing ultimately through the portæ, but also from these deep-seated vessels, the superficial vessels of the left lobe, and their trunks, perforating the diaphragm on the left ligament of the liver. The trunks of the two plexuses run along the suspensory ligament from below upwards; when they come to the diaphragm they perforate it, and pass into glands which are situated on the fore part of the pericardium, formerly described. Here they are joined by other trunks from the liver, to be presently described; and from these glands a large trunk emerges, which running under the sternum, between the laminæ of the anterior mediastinum, commonly joins the thoracic duct near its termination, but which not unfrequently communicates with the trunk of the right side. I believed that I was the first discoverer of this trunk; but I find, that in quadrupeds at least, I was anticipated both by Nuck and Rudbeck. On their authority, Haller says, "Alia a septo transverso ejusque convexa facie, retro sternum adscendentia per glandulas mediastini, ad eas usque quæ suprema sunt."—Rudbeck has actually delineated this trunk, in his book on the Lymphatic Vessels. Haller says, "Magnum ibi ductum pingit, pene similem thoracici huic fere summo insertum."—Nuck's words are, "Diaphragmatis pars convexa plurimos emittit ductus lymphaticos, qui coëuntes simplicem et aliquando duplicem in quovis latere componunt ramum ascendentem sub sterni musculo triangulari extensi glandulas subingrediuntur ad suprema sterni locatas, &c."—From Haller's authority, I find that Eschenback has published, in German, the same appearances. "Insignia vasa lymphatica ad ductum thoracicum retro sternum adscendere vidit, cumque iis ea quæ a convexo hepate veniunt." The absorbents from the suspensory ligament of the liver do not always perforate the diaphragm, or do not perforate it at the same place. I have seen a very large trunk run from the suspensory ligament to the left ligament, on the under surface of the diaphragm, between it and the small lobe of the liver, and which, joining the trunk on the left ligament, to be afterwards described, went with it at that place through the diaphragm. I

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have also seen this trunk, after it reached the left ligament of the liver, run under the diaphragm, without going through it, to be inserted into the thoracic duct, near the cæliac artery. I have also seen the absorbents on the suspensory ligament form two great trunks, equal in size to the middle part of the thoracic duct itself; these passed between the diaphragm and the superior edge of the liver, and ran downwards on the under surface of the diaphragm, over its crura, till they came to the uppermost of the lumbar glands; through these they passed into the duct.*

The next division of the absorbents, from the convex surface of the liver, lies on the right side of the great lobe; it forms sometimes the principal trunk, and, whether it forms the principal trunk or not, is hardly ever wanting. When it is largest, it arises sometimes as low down as the middle of the lower edge of the right lobe, from thence it runs obliquely upwards, in the direction of the right ligament of the liver; in its way it receives innumerable small branches, and very frequently even considerable trunks. I have seen, sometimes, almost the whole convex surface of the right lobe covered with its branches. When it comes to the right ligament, it penetrates the diaphragm, and, appearing on its upper surface in the cavity of the thorax, it takes the circular sweep of the ribs, and runs from behind forward, to go into the glands already mentioned, on the fore part of the pericardium, and to join the former trunks. One of its branches, thrice as large as a crow-quill, after it had perforated the diaphragm, runs backward, and climbing over the side of the spine, was inserted into the thoracic duct, behind the œsophagus, without passing through any gland. In its way to the mediastinum, the principal trunk also communicates frequently with others, which run with the phrenic nerves, to be mentioned hereafter. I have seen it divide at the place where it usually perforates the diaphragm, and one half go through the diaphragm, whilst the other run between the diaphragm and liver, and entered the glands of the portæ. This trunk, instead of perforating the diaphragm, frequently runs wholly on the under surface of that muscle obliquely, in the direction of the cæliac artery, and is near it inserted into the thoracic duct.

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* I have lately seen them passing into the duct without the intervention of these glands.

The next division rises from the upper surface of the small lobe of the liver, about the middle. It also runs obliquely from below upwards, in the direction of the left ligament of the liver. Its principal trunk also perforates the diaphragm, and, taking the sweep of the ribs, runs from behind forward, and terminates also in the glands, upon the pericardium, already mentioned. I have seen some branches from it also run backward, and terminate in glands upon the œsophagus, immediately above the diaphragm. I have seen other vessels from the same quarter taking the same course, and passing under the aorta to the thoracic duct. While I was injecting the absorbents on the small lobe of the liver, in April 1773, the mercury entered the principal trunk, but presently stopped in that absorbent, though it continued still to flow from the injecting tube. I suspected, at first, that the quicksilver, by its weight, had ruptured the vessels, and was running off into the cellular membrane; but in a few seconds I was agreeably disappointed, by seeing the mercury return from several absorbent vessels, which were rising out of the substance of the liver, and which, running upon the left ligament of the liver, joined the trunk I had been injecting. I afterwards slit open that branch of the vena portarum, which ramifies through the small lobe of the liver, and found that the mercury, which had escaped from my sight during the injection just mentioned, had been filling the deep-seated absorbents, which were now seen running in great numbers on the outside of the branches and part of the trunk of the vena portarum, and that it was from these deep-seated ones that the superficial branches on the left ligament had afterwards been filled.

The description I have given of the absorbent vessels on the convex surface of the liver, is that of their usual appearance; but I have often seen six, eight, or ten smaller trunks running upwards, towards the diaphragm, between the right ligament and the suspensory ligament, and four or five others, in the same situation, between this last ligament and the left one. These sometimes perforate the diaphragm, and, joining some of those on its upper surface, form a plexus, which runs with the mammary arteries and veins of each side, under the cartilages of the ribs, passes through small glands in the course of those vessels, and terminates at last, those of the left side in the thoracic duct, those of the right side in the second trunk of the absorbents. They are also sometimes joined by trunks from the glands on the pericardium, already described.

The absorbents on the under surface of the liver seldom put on any very regular appearance; and when they are seen upon the surface, and are injected, they are quickly lost in the deeper-seated set. One plexus, however, I have observed pretty constant; it begins on the lower edge of the great lobe of the liver, near the bottom of the gall-bladder; it runs over all that part of the gall-bladder which is turned from the liver, that is, the whole of its under side, from its fundus to its neck; and I have sometimes seen that side of the gall-bladder entirely covered with absorbents. When I injected these with quicksilver, they passed at last through glands situated at the neck of the gall-bladder, afterwards through other glands, lying on the trunk of the vena portarum, from whence they passed into the thoracic duct, behind the pancreas. It was here that I found, on examination, that I had injected, contrary to the course of the valves, the absorbents of the spleen and pancreas, through the whole length of the latter nearly.—This plexus of absorbing vessels I have usually distinguished by the name of *plexus cysticus.*—The deeper-seated absorbents accompany the vena portarum every where through the liver, and in quadrupeds appear to be the principal plexus. By making ligatures, in living animals, on the trunk of the vena portarum, before it enters the liver, I have inclosed the trunks of the absorbents coming out, which cling to its outside; I have then seen them turgid with their own lymph, and diverging through the substance of the liver, in the same manner as the pori biliarii; yet, in the human subject, the deeper-seated ones anastomose so much with the superficial ones, which I have already described, that I am confident the greatest part of the lymph of the liver passes through them, probably with a view to diminish the quantity of fluid, which otherwise must have ascended against gravity in the thoracic duct.—The deep-seated plexus, as it comes out of the portæ, I have called *plexus portarum*; it consists of a great number of absorbent vessels, which pass into glands upon the trunk of the vena portarum, which afterwards form trunks, which are inserted into the thoracic duct, near the origin of the superior mesenteric artery.—This plexus is very well described by Haller: " Abeunt in fasciculum vasorum numerosorum,

rosorum, qui adit glandulas conglobati generis quæ in fasciculum vasorum hepaticorum per portas euntium se immiscent, et vesiculæ felleæ cervici etiam adsident. In cane et in capra manifestum plexum pellucidum vidi, in gazella parisini, alii in aliis animalibus. Eadem trans pancreas arteriam mesentericam ad aortam usque sequuntur, et uno pluribusve ductibus, inseruntur vesiculæ chyli, ductuive thoracico, commista cum vasis lacteis secundi generis, aut supra eadem."

From the description I have given, and from the annexed engraving, it will appear, that the liver has a greater number of absorbents than any viscus I have yet described. I have said, that the absorbents are at least double of the arteries and veins. Now the liver is one of the most vascular parts in the body; it was for this reason that the ancients considered it as the fountain of the blood; it was this made Asellius precipitately conclude, that the lacteals were carrying the chyle to the liver, that it might there be converted into blood. But if the blood-vessels are so numerous, and if the absorbents are at least double their number in other parts of the body, it is not astonishing that they should be so numerous here. We do not know the whole functions of the liver; we know that its principal use, in the adult, is to secrete the bile; but then in the fœtus it occupies the greater part of the cavity of the abdomen, when the bile is but little wanted, and a considerable portion of the blood, returning from the placenta, circulates through its substance; it occupies a less space, in proportion, in the cavity of the abdomen as the body grows up, and it is more than probable that it performs some function not yet understood. Till that function is understood, the whole of the office of the absorbents of the liver cannot be explained. In all other respects, they perform the same offices here as in other parts of the body.

THE ABSORBENTS OF THE DIAPHRAGM.

These are so blended with the absorbents of the liver, that they are already of course described. I have seen other trunks from the liver perforating the diaphragm, going into glands on the right and left sides of the pericardium, and afterwards ascending on each side of the phrenic nerves. Those of the right side terminate in the second trunk of the absorbents, those of the left side in the thoracic duct.—The absorbents of the diaphragm are exceedingly numerous, and enter some one or other of these trunks, and are seen principally on its upper surface. I had lately an opportunity of seeing these vessels filled with their own lymph, in a gentleman who was shot. I once also saw them filled with chyle from the mesentery, and which had passed through the substance of the liver, to the number of 300 or more, as I observed in a former part of this work; so that Asellius might still be forgiven for asserting that he saw the lacteals going to the liver, "ad hepar euntia." Veslingius asserts the same thing. There are other absorbents, however, on the under surface, which I have also seen accompanying the phrenic arteries, which may be termed *phrenica inferiora.*

THE ABSORBENTS OF THE HEART.

Though I have divided the absorbents of the viscera into two sets, a superficial and deep-seated, in reality, there is no distinction naturally, they all arise at first from the deep-seated parts: I shall, therefore, having premised so much, describe those absorbents of the heart which lie upon its surface.—Haller, in the first volume of his Physiology, speaking of the lymphatics of the heart, uses the following words, "Quin adeo in homine, vasa pellucida in corde inveniantur, minime dubito etsi neque vidi, neque ill. Senac." But in his fourth volume he says, "Ipso tamen in corde, vasa lymphatica vidi, principe musculo." He had, therefore, seen them in the interval between the writing of the one volume and the other.—Mr. Hewson, conscious that he also knew nothing of them, refers his readers to Nuck; whose description of the lymphatics of the heart, as taken from a quadruped, without acknowledging it, has made his whole work on this subject suspected. Haller says, "ad ea quæ edidit utique brutis animalibus usum esse constat, vel cordis exemplo." Mr. Hewson says, "These lymphatics from the anterior part of the lungs are probably accompanied by those of the heart, which are represented by the accurate Nuck, in his Adenographia,

graphia, fig. XLI."—When Haller says, in his fourth volume, that he saw the lymphatics of the heart, it must have been in the heart of a quadruped; for he says, even in his last edition of his Physiology, printed in octavo, at Lausanne, "Et ego in vivente capella, sub aure sinistra, vera et valvulosa lymphatica vidi." And in the same section he still says, "Neque ab humano corde ejusmodi venas abesse probabile fit;" and concludes the section, as in the former edition, "Quin adeo in homine vasa pellucida in corde reperiantur, minime dubito, etsi neque ego vidi, neque ill. Senac, neque nuper cl. Gulielmus Hewson."—The fact is, the absorbents of the heart are very easily discovered, even by the naked eye, previous to injection; but, on macerating the heart in water for several days, shew themselves still more distinctly; for an elastic vapour, let loose into the cellular membrane from putrefaction, and which puts on the appearance of air, enters the mouths of the absorbents, and, passing along their branches and trunks, distends them to the utmost. Nothing more is necessary than to make a puncture in the extremity of the principal trunk; the absorbent, through its whole course, instantly expels the air, though contrary to the valves; the anatomist has only to introduce a tube, filled with quicksilver, into the orifice through which the air was expelled, and he will easily fill the vessels that were formerly filled with air, as far as the glands themselves, which are not situated upon the heart, but, as we shall see presently, behind the middle of the arch of the aorta.—As there are two coronary arteries in the heart, one belonging to the left ventricle, and the other to the right; and as the left ventricle is three or four times thicker than the right, the left coronary is, of course, three or four times larger than the right. The right coronary runs between the right auricle and the pulmonary artery, whilst the left runs between the left auricle and the same artery; the trunks of the absorbents run with them, and bear a similar proportion as to size. I have been able, with injections of mercury, to cover almost the whole surface of the heart with their branches. The right coronary trunk of the absorbents, having accompanied the right coronary artery till it comes to its origin at the aorta, then runs by itself over the anterior surface of the arch of the aorta, and, passing between the right and left carotids, near their origin, enters a gland a little behind that part. The left coronary trunk of the absorbents is formed by two great branches; one of these arises near the apex of the heart, and runs in a groove exactly over the septum ventriculorum, on the superior surface of the heart. The other arises likewise near the apex of the heart, but on the opposite side, runs at first in a kind of groove between the two ventricles, and, having reached the interstice between the auricles and the ventricles, makes a semicircular turn from below upwards and inwards, and, having joined the other branch near the origin of the left coronary from the aorta, the trunk which they have composed passes under the pulmonary artery till it comes to its bifurcation; it then runs up in the angle between its two crura, and, running upon the posterior side of the middle of the arch of the aorta, enters a gland between it and the root of the trachea. At this place the glands belonging to the heart and to the lungs are, in some measure, blended together, and the trunks arising out of them do not belong wholly to the heart, but also to the absorbents of some part of the lungs. The trunk corresponding to the right coronary passes over the trachea, in the posterior mediastinum, to join the trunk of the absorbents on the right side of the neck. The trunk corresponding to the left coronary passes also with the trachea, and joins the thoracic duct, near its insertion. Sometimes both of these trunks pass into glands in the neck before their insertion into the great trunks; but in the best injection I ever made of them, they terminated immediately in those trunks of the system. There is very frequently a third trunk, belonging to the left ventricle of the heart; it runs in the middle, between the two former, and joins them, as they are passing under the left auricle.

THE ABSORBENTS OF THE LUNGS.

Next to the liver, the lungs are that part of the body in which I have found the greatest number of absorbent vessels. Rudbeck appears to have been the first who had seen and delineated the absorbents of the lungs; from the figure, however, it could only be one of the trunks coming out of their substance, and running to the root of the lungs, which he had seen. After him, Willis, in his Pharmaceutice Rationalis, published in 1675, having described the blood and air vessels of the lungs, says, " Huic vasorum prædictorum, quibus aer et sanguis convehuntur, triumviratui lymphæductus aquam exportantes adjunguntur. Horum ingens satellitium, per pulmones depositum, arterias et venas stipat: surculi omnes; a pulmone exteriore, versus radices ejus tendentes, in plures truncos majores coëunt, qui, ductui thoracico communi inserti, lympham, à sanguine et humore nerveo superfluam, ingerunt." He does not say from what animal his figure is taken; but, from what he says in the same chapter, one is led to suppose that it is the dog. " Hæc vasa pulmonum lymphica optime conspiciuntur, si inter canem vivum dissecandum, ductus thoracici summitatem, ut nihil vena subclavia infundatur, comprimas: tunc enim pulmonum lymphæductus, siquidem in commune receptaculum obturatum ac repletum sese exonerare nequeant, summè intumescunt, et valde conspicui fiunt."

Winslow cautions us, not to take the appearance of the inflated or otherwise distended cellular substance, interposed between the constituent lobules of the lungs, for lymphatics; "Dans la surface du poumon de l'homme, entre la tunique interne et la tunique cellulaire, on découvre des traces semblables à celles des vaisseaux lymphatiques; mais il ne faut pas se méprendre en voyant paroître sur la surface du poumon un raiseau très-transparent, après qu'on a fortement soufflé dans un lobe; car c'est l'air qui a passé au travers des cellules ou vesicules bronchiales dans les cellules interlobulaires, qui a fait un écartement de plusieurs petits lobules, et c'est logé dans les interstices de cet écartement. Les vrais vaisseaux lymphatiques du poumon sont plus visibles dans les animaux. J'ai vu dans le cheval un vrai vaisseau lymphatique ramper tout le long d'une grande portion de l'un des bords du poumon." Accordingly Haller, speaking of Ferrein's description of those vessels, says, " fusius hæc ill. viri vasa lymphatica, et ex homine describuntur." And afterwards he says, " Dicuntur in rete coire, sequens spatia inter lobulos posita, totque retia esse, quot lobuli, p. 74. ubique vero æque ampla esse, absque ramis, et valvulis; et ex profunda pulmonis compage radiculis suis nasci: quolibet rete aliud contineri. Hæc descriptio mire spatia cellulosa refert." Notwithstanding Haller's insinuation to the contrary, the greater part of this description of Ferrein's is perfectly accurate.

The absorbents of the lungs are also divided into two sets, a superficial

cial and deep-seated. The superficial set, like those of the other viscera, are not always to be found. I have been able, at one time, to shew the whole external surface of the lungs covered with the absorbents I had injected; at another time I have not been able to find one. The same thing I have known happen frequently in the liver, as I have already said. One of the easiest methods of finding them is to inflate the lungs of a still-born child from the trachea; the air passes instantly from the air-cells, and filling all the absorbents, enables us to see particularly the superficial absorbents; if a puncture is then made with a lancet into any one of those absorbents, the air will escape, and quicksilver may then be injected in its place, as the valves hinder it from escaping into the air-cells: this is difficult to conceive, but I have notwithstanding always found it so. One of the most perfect preparations I ever made of the absorbents of the lungs, was in this way. Perhaps infectious particles may enter as readily: it would be unfair from an experiment of this kind, made in a dead body, to infer any thing respecting the living; for if transudation takes place in dead bodies, and not in living, this phænomenon may be one of those connected also with a loss of living principle in the lungs. Winslow's observation, respecting the appearance of the cellular membrane forming areolæ, which surround the smaller lobes of which the lungs are composed, and which communicate with one another, and when inflated resemble lymphatic vessels, is also perfectly just: if a puncture is made with a lancet, not sufficiently deep, between the areolæ, and air is thrown in at that puncture, the appearance he describes is constantly produced; but if the lancet is pushed a little deeper, an opening will commonly be made into an absorbent, and if air is thrown into that opening, an appearance not unlike the former will be produced, but which, notwithstanding, is the real appearance of the absorbents. When mercury is thrown into those vessels, it discovers at first a coarser net-work in the interstices of the smaller lobes, "vasa concatenata reticulum facientia," as Haller expresses it; but if a ligature is made on the trunks of the absorbents at the root of the lungs, and the injection is pushed to the utmost, another net-work is discovered within the former, immensely delicate and fine; and the whole surface of the lungs may, in this way, be shewn to be covered with absorbents. It has been said by some, that the absorbents here have no valves: this assertion is not true. The same remark has been made with regard to the smaller absorbents on the surface of the liver, but is equally ill founded; the anastomoses between the branches is so great, that the moment the quicksilver enters one of the larger vessels, it is seen running in every direction: but this is not owing to the want of valves, but to the circumstance I have already mentioned: besides, the valves in the smaller branches do not so accurately shut the cavities of the vessels, in the dead body, as in the larger branches. The superficial absorbents terminate at last in glands at the root of the lungs, where they are joined by the deeper-seated absorbents. These last ramify through the lungs in the same manner as the pulmonary artery and veins, and cling to their coats; but are found in greater numbers on the outer surface of the branches of the trachea. These I have constantly injected from the superficial absorbents; indeed it is hardly possible, either here or in the liver, to inject the superficial absorbents, and not to inject, at the same time, the deep-seated ones. From the glands at the root of the lungs, trunks, corresponding to both sets, arise. In the left lobe of the lungs, several trunks unite, and form a very large one, which I have sometimes seen equal to an ordinary goose-quill in diameter; this is inserted into the thoracic duct, immediately behind the bifurcation of the trachea. Another trunk runs up on the posterior part of the trachea, between it and the œsophagus, and terminates in the thoracic duct near its insertion. A third trunk joins those glands in which the absorbents of the heart terminate, and is inserted at last as they are. The absorbents of the right lobe of the lungs also form three and sometimes four trunks, as they emerge from the glands placed at the root of the lungs; one of these trunks runs upwards over the anterior surface of the cava superior, and, having formed in its course numberless and most elegant convolutions, terminates at last in the second trunk of the absorbent in the right side; another, after forming similar convolutions, passes also into the thoracic duct, behind the bifurcation of the trachea; a third, without forming any convolutions, passes with the trunk of the vena azygos, and is inserted into the duct near the origin of that vein. I have sometimes seen a fourth trunk, which ran downwards, and was not inserted into the thoracic duct till it reached the diaphragm. Some of the absorbents of the right lobe almost constantly communicate with that trunk of the left lobe, which I described as passing behind the trachea.

The absorbents of the lungs are exceedingly numerous, for the same reason as those of the liver. I have frequently shewn the whole surface of the lungs, in the fœtus, covered with absorbents filled with air, by blowing into the trachea; I have afterwards dislodged this air by punctures, and made quicksilver take its place. The velocity of the blood through the lungs, according to Dr. Hales's calculation, is at least five times greater than that in most other parts of the body; if absorption here takes place in a similar proportion, it will be greater than in any other part of the body: if the absorbents here take in noxious miasmata from the atmosphere, a greater accumulation of these will take place in the lungs, and their first action will be on this viscus, and perhaps may induce consumptions. I have several times known breathing putrid air produce pulmonary consumption; and it is well known that breathing the same air, in the apartments of consumptive people, has infected those who were obliged to be much with them. Perhaps more is to be attributed to the variable state of the weather in this island, and to the cold and moisture of our atmosphere, producing debility, and occasioning scrophulous inflammation of the lungs: however this may be, I know no remedy, in this disease, equal to the change of climate, and breathing purer air. I have known patients recover in Italy, and in the south of France, who would have died if they had staid here.

THE ABSORBENTS OF THE ŒSOPHAGUS.

Rudbeck has delineated a considerable absorbent passing from a gland about the middle of the fore part of the œsophagus, and which, running upwards, soon enters the thoracic duct. This gland has been taken particular notice of by Vesalius, as having something peculiar in it, and not to be found in other lymphatic glands. Vercellonius imagined, that it secreted a salt fluid, which was of use in digesting our food. Morgagni restored it to its place amongst the other lymphatic glands. I believe that it belongs to the absorbents of the heart and lungs, as well as to the œsophagus; nor is there one or two only, but a number of glands, in the course of the œsophagus,

as formerly described. Haller says, " Earum aliqua, aut duæ, quæ magnitudine forte excellerent, tamquam solæ ea in sede essent, aut aliquid singulare haberent, pro dorsali quadam propria glandula a Vesalio descriptæ sunt: eam glandulam J. Vercellonius celebrem reddidit, cum salsum in ea, et digerendis cibis utilem succum, secerni sibi persuasisset. Verum omnino neque unica est, ut hi viri putarunt, neque duæ, aut alii, neque quatuor aut quinque, ut Whartonus et alii, sed omnino numerus et incertus est, et constanter magnus, uti recte monuit vir cl. Mauchardus. Lymphaticæ tribui vindicavit, qui tot alios errores felici ingenio profligavit, primarius professor Patavinus."—Morgagni.

I have seen the œsophagus covered with absorbent vessels from one end to the other. I have said that these absorbents are blended with those of the heart and lungs, and of the surrounding parts; but that they belong also to the œsophagus, I am perfectly certain: they arise out of it in the same manner as from other parts: nor can I conceive why Haller should express himself as he has done on this subject. He says, " Lymphaticæ venæ œsophagum numerosæ perambulant, qui totus conglobatis glandulis tegatur. Num tamen ex gula quidquam sugant, num potius ad telam cellulosam pertineant, quæ pleuræ exterior circumponitur, nunc quidem non possum definire."

In strictures of the œsophagus, I have known patients live for many months without any other nourishment than what must have been absorbed from the œsophagus, or from the inside of the mouth. In one instance, the food constantly stopped a little above the cardia, and in three or five minutes after was vomited up again, by the action of the muscular fibres of the œsophagus alone: this patient, though afterwards cured by the use of the bougie, had remained some months in the above-described situation.

THE ABSORBENTS OF THE INTERCOSTAL SPACES.

These I have repeatedly injected with quicksilver from the thoracic duct, contrary to the course of the valves. I have even made the injection pass the small glands situated between the heads of the ribs, and seen the mercury run for some way into the intercostal spaces through these vessels;

two accompany each intercostal artery: and on one occasion I also injected their posterior branches, which then run backwards to the skin and muscles of the back, with the posterior branches of the intercostal arteries: in this subject they perforated the body of one of the vertebræ of the back, through whose substance I afterwards saw them ramifying. A demonstration that they also went to, or more properly came from, the bones.

THE ABSORBENTS OF THE UPPER EXTREMITIES.

Haller says, that he knows little of them, unless the flow of lymph, which for days sometimes follows venesection in the arm, is to be referred to this head. "Superioris artus vasa lymphatica—quorum in homine certa fide visorum tenuis iterum notitia ad nos pervenit, nisi lymphæ colliquationes ex venæ sectione natas huc referas, uti quidem referri possunt."

Van Horne is said to have been the first who saw those vessels in the human subject, and that he obtained this point by making a ligature upon the arm of a young man some hours before his death. "In juvene post vincula paucis a morte horis injecta, in brachio ostendisse dicitur." Nuck has represented them both in the upper and lower extremities; but, besides that he has, in another part of his work, substituted the heart of a quadruped, with the absorbents on it, in the place of the human heart, which of course makes his account of them suspicious; the vessels he has represented on the extremities, are not like any thing I have seen. It appears also, that Hagen saw these vessels very distinctly in an œdematous arm. "Deinde," says Haller, "cl. Hagen in brachio œdematoso vasa lymphatica, eaque prægrandia et flexuosa, vidit." The absorbents of the upper extremity, like those of the lower, divide themselves into two sets, a superficial and deep-seated. The superficial run with the cutaneous veins; the deep-seated accompany the arteries. The cutaneous veins form two great trunks in the arm; of these the basilic is the principal. The greater number of the superficial absorbents accompany this vein: they arise from the palm of the hand, and from the back of the hand on the side next the little finger; they run at first with the veins named ulnaris externa et interna of Winslow. I have injected these with quicksilver, in the human subject, to the number of ten or twelve. Afterwards they join the trunk of the basilic; they sometimes pass into glands situated upon the brachial artery, near the internal condyle of the humerus; sometimes they do not pass into the glands till they come to the middle of the humerus, and sometimes not till they come to the axilla: they are very much spread out on the fore-arm, and occupy a space from three to four inches in breadth; but when they come to the humerus, they come nearer one another, and lie close upon the basilic. Haller says, "Hæc brachii vasa aliquando in venæ sectione pertusa, molestissima et diuturna lymphæ profluvia faciunt, quale et ipse vidi." I have never seen any such flow of lymph from bleeding in the arm. When students of anatomy have happened to wound themselves, in dissecting the dead body, either on the little or ring finger, the red lines, which appeared in consequence of this, constantly took the course I have now mentioned. Mr. Hewson appears to have been less successful in his discoveries here than in the lower extremity; which may account for Haller's expression, "tenuis notitia." I have injected other absorbents, arising also from the palm of the hand, on the side towards the thumb, which ran on both sides of the flexor palmaris muscle, and, at the bending of the joint between the arm and fore-arm, joined the plexus last described, but did not pass into any glands till they came to the axilla. The absorbents which accompany the cephalic vein, arise from the sides of the thumb and fore-finger, upon the back of the hand; they run at first with the vein called by Winslow the radialis externa, but at the bend of the arm join the cephalic, with which they run upon the outer edge of the biceps flexor cubiti; they run in this direction for some way, but soon get between the inner edge of the deltoide and outer edge of the pectoralis major, after which they pass under the clavicle, and are inserted into glands upon its inside.

There are other absorbents on the back of the hand, on the side next the little finger, which turning round with the ulnaris externa, are inserted at last into a gland almost constantly to be found upon the anterior surface of the inner condyle of the humerus: from this gland a very large vas efferens goes out, which almost immediately joins the brachial artery, and then splitting into two, accompanies it all the way to the axilla; and its branches are inserted into the axillary glands. If venereal matter is absorbed any where from the hand, near the little or ring finger, or from those fingers themselves, the gland on the internal condyle of the humerus, or some one in the course of the brachial artery, will most probably inflame, and form a bubo, and the intelligent practitioner will be warned of this absorption; but if the venereal matter is absorbed from the thumb or fore-finger, or from the hand in their vicinity, it is possible that it may not pass into any glands, until it comes into the inside of the clavicle; these are out of the reach either of our sight or feeling, and the patient may be infected, without the practitioner's having even suspected it.

The deep-seated absorbents of the arm accompany the arteries in the same manner as the veins do, two with each artery. I have seen two with the radial artery, two with the ulnar, two with the internal interossial, and I have already described two with the brachial artery; these at last all terminate in the glands of the axilla: from these glands considerable vessels go out, which at last uniting, contribute to form, in the right side, one great trunk, which I have already called the second trunk of the absorbent system; and in the left side form a trunk, which either joins the thoracic duct near its termination, or is inserted by itself into the subclavian vein adjoining.

The absorbents from the muscles and integuments on the posterior part of the scapula, also terminate in the axillary glands; I have frequently injected them from those glands, contrary to the valves. Haller, apparently quoting from Mr. Hewson, says, " Ad glandulas demum axillares veniunt —ibi conjunguntur cum vasis profundis, arteriam radialem et procul dubio ulnarem et interossiam comitantia."

THE ABSORBENTS OF THE THYROIDE GLAND.

The trunk of the absorbents in the right side, and the thoracic duct in the left side, are joined near their termination by two trunks from the thyroide gland. I have frequently inflated those trunks, by plunging a lancet at random into the substance of this gland, and throwing in air or quicksilver, as we generally do in absorbent glands; a method first practised by

Mr. Hunter. Haller has also seen these vessels; and says, "Numerosa etiam vasa aquosa sunt thyroidæ glandulæ."—There is not any part of the body more vascular, in proportion to its bulk, from arteries, veins, and absorbents, than this gland; but, as I have not the least conception of its use, I do not understand what functions in particular its absorbents perform.

THE ABSORBENTS OF THE THYMUS GLAND.

These I never looked for, as it is a part which does not exist in the adult body. Haller mentions its absorbents, on the authority of Pauli; and, speaking of the absorbents of the neck, and their termination, says, "Non sine aliqua a thyma advenientium vasculorum accessione."—I know not the use of this gland; of course, not the particular use of its absorbents. It resembles, according to Haller, the absorbent glands of the mesentery, in containing a similar globular fluid as they do, and in disappearing at last entirely: but there is certainly a very material difference; the thymus, at, or soon after birth, is larger than all the absorbent glands of the mesentery taken together; it does not at all resemble them; and disappears totally about twelve or fourteen years of age. The lymphatic glands of the mesentery, if they disappear at all, are, at least, visible on the mesentery at seventy, and even eighty years of age. This gland, the thyroide, the spleen, and the capsulæ renales, are remarkable in not having, like other glands, any *excretory duct.* Mr. Hewson said, that their lymphatic vessels were also their excretory ducts. Ruysch had previously said, the lymphatic glands were not like other glands, chiefly in not having excretory ducts; but he supposed their lymphatic vessels might perform that office, "*excretorios ductus illos putavit.*" * Of the thymus in particular, Mr. Hewson said, that the globules found in it resembled the central particles of the blood, and he persuaded himself that the use of the thymus was to furnish these particles, and the use of the spleen to apply them in forming globules of blood. The lymphatics carried these particles from the thymus into the blood; they were then deposited by the arteries into the spleen, the great workshop of red blood, and there converted into central particles; and thence the finished globules of blood were constantly found coming out of the spleen through the cavities of its lymphatics. I have not been able to find the central particles of the blood, nor this alleged appearance in the lymphatics of the spleen. The lymphatic glands also contain similar particles, which Mr. Hewson also supposed were converted into central particles of the blood. He imagined that, as during the formation of the body much blood was wanted, the thymus was for this purpose formed as a great lymphatic gland, but when the body was nearly finished, the assistance of this gland was no longer wanted; and this was the reason of its disappearing so soon as at twelve or fourteen years of age, the common lymphatic glands being, of themselves, then adequate to the business of furnishing central particles. To this I have only to object, that birds have no thymus, and only two lymphatic glands, that fishes have neither thymus nor lymphatic glands, and notwithstanding have the red globules of blood, as numerous and as perfect as any animals whatever.

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* Mekel.

THE ABSORBENTS OF THE HEAD.

I formerly expressed myself as having met with more difficulty here than in any part of the absorbent system; nothing that I have since read or seen has in the smallest degree contributed to throw more light on the subject. The absorbents of the head divide themselves into two classes, the external and internal; there is no difficulty, no doubt, respecting the former; all the uncertainty rests with the latter. Haller says, "In capitis equidem regione subcutanea vasa lymphatica passim reperiuntur." And afterwards says, "in cerebri equidem interiori regione, eorum nonnulla passim vestigia reperiuntur."

EXTERNAL ABSORBENTS.

These I have injected, with every branch of the anterior temporal artery, posterior temporal artery, and occipital artery, on both sides of the head. They lie two and two on each side of these arteries, as the lacteals do by the sides of the arteries of the intestines, or the lymphatics with the arteries of the extremities. The branches of the anterior temporal lymphatics sometimes terminate in glands above the zygomah process; these glands are often wanting, and always very small when they are found, but I have seen them, occasionally, enlarged from disease. The principal temporal absorbents pass through glands over and under the parotid gland; the former I have known indurated and enlarged to the size of a hen's egg, which gave suspicion of cancerous affection in the parotid itself, which, notwithstanding, lasted many years without any bad consequence; the absorbents which pass over the parotid, pass through its substance, and pass under it, belong to the temporal absorbents, and terminate both in the superficial and deep-seated plexus of the neck. The occipital absorbents, or those accompanying the occipital artery, terminate in a gland, or glands, on, or behind the mammillary process, and hardly ever wanting; these glands often swell to a very large size, inflame and suppurate, from the affection of their absorbents in the *tinea capitis*, a disease often owing to neglect in not washing children's heads every day, from their birth, till they have passed their second year. The wash should be soap and cold water. These absorbents terminate at last in the plexus of the neck, accompanying the external or internal jugular veins.

INTERNAL ABSORBENTS.

Haller speaking of those says, " In cerebri ventriculis, glandula pituitaria, et infundibulo, apud Marchettis. In cerebro et plexu choroideo apud Ridley, ipsumque Nuckium. In dura matre, ad glandulas sinui falciformi adsidentes, nuperus apud Danos prosector. In pia matre alii scriptores, Lancisius, Pacchionus, et Fantonus, et in comitatu nervorum olfactoriorum versus nares B. Carr, in Epistola Leidæ impress. anno 1683. Verum dudum de his per cerebrum lymphaticis vasis dubia moverunt viri insignis his in rebus auctoritatis Brunner et Zellerus, neque unquam aliquid simile vidi; et obest quod nullæ intra cranii caveam glandulæ lymphaticæ reperiantur, quales a ductibus aquosis non longe abesse solent."—I have doubts, as well as Haller, of the descriptions given by these anatomists of the absorbent vessels of the brain; not that they do not exist: but there are such variety of appearances in the brain, that persons not accustomed to the injecting absorbents might mistake them. Mr. Hewson could not find their branches, after he had tied up their trunks, in the neck in living animals. The brain is a viscus which so soon becomes putrid, that we cannot trust to the gradual extrication of vapour, as in other parts, for the discovering of these vessels; and they must also be then so tender, as every part of the brain is, that they will hardly bear a column of quicksilver without presently bursting:—in firmer brains, and on some more fortunate occasion, it may prove otherwise.—The circumstance urged by Haller, of there being no lymphatic glands within the cranium, is not material. There are none on the legs or fore-arms, yet there are a vast number of absorbents. There are none on the outside of the cranium, above the mammillary processes, yet the absorbents are as evident and numerous as in any part of the body.—I shall relate what I know, and have seen, respecting these absorbents of the head.

There is the appearance of absorbents on the surface of the brain, between the tunica arachnoides and pia mater. Ruysch was the first who observed this; he has given an engraving of them, inflated with air, and calls them *vasa pseudo-lymphatica.* I have repeatedly injected them with quicksilver; but, as they appear to me too large, and to be destitute of valves, the great characteristic of absorbent vessels, and as I have not traced them to the glands, I have not yet determined what they are. They may be absorbents without valves, as the fluids, coming from the brain, have the assistance of their own gravity in descending, and the valves would have been of no use, perhaps, in vessels not exposed to the contraction of surrounding muscles.—That the brain has absorbents, I am perfectly certain; for I have seen absorbent glands in the *foramen caroticum,* which, from this situation, could not belong to any vessels but such as were coming down from the brain. The glands of the neck swell in some diseases of the brain: I have seen this particularly in scrophulous abscess of the brain; I found the glands of the neck swelled with affection of the brain, in the living body, and I found the abscess after death;* nor should I believe any vessel to be an absorbent which, coming from the brain, did not terminate in the glands of the neck. From these glands the deep-seated absorbents of the head go into other glands, in the course of the internal jugular veins and carotid arteries; and, having been joined by those from the outside of the head, they form larger and larger trunks, as they come nearer the angle between the jugular and subclavian veins, and are blended with the other absorbents of the neck.

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* Particularly in Mr. B.

THE ABSORBENTS OF THE FACE.

These I have often seen, in great numbers, accompanying the external maxillary artery through all its branches, coming from the inner angle of the eye, from the nose, and from the lips. Some of them pass through glands on the buccinator muscle; but the larger trunks commonly pass through glands situated on the basis of the lower jaw, near the anterior edge of the masseter muscle, and in the course of the trunk of the external maxillary artery. Haller, in speaking of the absorbents of the head, mentions those of the face: " Mihi in facie, massetere musculo, parotide, margine nudo maxillæ inferioris etiam in homine innotuerunt."—Those from the nose accompany chiefly the internal maxillary artery, and pass through glands under the parotid, and in the course of the trunk of that artery. Those from the gums, alveolar processes of the teeth, and tonsils, accompany the same artery; but after they pass the angle of the lower jaw, join frequently the external jugular vein, and pass through glands on the top of the shoulder. Those from the tongue, tonsils, and muscles of the os hyoides, also pass through the glands lying on the internal jugular vein, below the angle of the lower jaw. Haller also has seen these. " Alii veniunt a musculis ossis hyoides et pharyngis et linguæ, et ex ipsa demum lingua; hæc quidem satis dudum a me visa, et a larynge denique." These glands I lately saw exceedingly enlarged in a woman, who caught a putrid sore throat the third week after lying in, from going out too soon; she died in three days. I have seen similar tumors, in scarlet fevers, suppurate and discharge the most fetid pus I ever smelt.

THE ABSORBENTS OF THE NECK.

The vessels I have now described, as well as those of the head, I have said, pass through glands in the neck; these I have already described as exceedingly numerous, and accompanying both the jugular veins and carotid arteries. The vessels and the glands together form the grandest plexus of absorbents, perhaps, in the body. The appearance of these vessels of the head, face, and neck, are only expressed, as it were, in outlines in the annexed figure, as I have reserved this for some future opportunity.—After passing through a number of glands on the sides of the neck, the absorbents form at last common trunks; that of the right side is inserted into the second trunk of the absorbents, and that in the left side commonly joins the thoracic duct, near its termination. Haller had seen this plexus; and says, "Descendunt cum ea glandularum serie quæ jugularem venam ad cavam superiorem comitatur.—Hæc omnia in trunculos unita cum ramis a capite descendentibus et comitibus ramorum arteriæ carotidis demum, &c." The absorbents of the nape of the neck, and from the integuments and muscles between the scapulæ, also pass through the glands situated on or near the mammillary processes; after which they also run downwards along the external or internal jugular veins.

THE ABSORBENTS OF THE BREASTS IN WOMEN.

The *mammæ*, or the glands commonly termed the *breasts* in women, are destined by nature to secrete milk, soon after delivery, for the nourishment of the child; and this secretion continues as long as the child continues to suck, and ceases on its ceasing to suck. This secretion is renewed after every delivery, ceases soon after, if the mother does not become a nurse, and ceases, or at least is almost stopt, if, notwithstanding her being a nurse, she should be impregnated again; which, though not often, happens sometimes. If a woman continues to suckle a number of children in succession, it is impossible to say how many years this secretion of milk may last, perhaps six or eight. In cows, milking, as it is termed, or the pressure and dragging of fingers, has the same effect as sucking; and sucking alone has stimulated, sometimes, the breasts of women to secrete milk, contrary to nature. These glands, then, differ from all the other glands in the body, in this, that all other glands having begun to secrete their proper fluids, continue to secrete them ever after, unless they become diseased, or, like the *thymus*, are temporary; but it is peculiar to the mammæ to secrete their fluids at certain periods only, whilst at all other times they become quiescent, or remain stationary, if I may use the expression. The testicles in men are said sometimes to be in the same situation, that is, cease secreting for a time, and afterwards take it up again. The *mammæ* at the time of birth contain milk, both in boys and girls; a very singular phænomenon, and not yet properly accounted for: they continue to secrete it for some days after birth, during which period, we sometimes find them inflaming, and even suppurating, from the same cause as in women after lying-in; that is, from a large secretion of milk not passing off easily by the nipples, of course distending the breasts too much. Boys at birth, therefore, have the glandular substance of the breasts, as well as girls; but in the boy it soon obliterates, except in some rare instances, where boys continue increasing in those parts in the same proportion as girls, and at sixteen or eighteen are as large in their mammæ as girls then commonly are. In girls, though the glandular substance does not obliterate after birth, it continues in a kind of dormant or stationary state, till the age of fourteen or sixteen, when it enlarges rapidly; or till they are impregnated, when it enlarges still more. This enlargement is then accompanied with shooting pains, the mark by which some women know, most certainly, that they have conceived. They enlarge again on the third day after delivery, and this enlargement is also accompanied, in many women, with shooting pains, tension, and tenderness. This occasions rigor, quickness in the pulse, some thirst, and restlessness, and by some has been called the milk fever. The absorbents of the boy's breasts vanish with the glandular substance, except those of them which belonged also to the integuments, muscles, bones, blood vessels, and cellular membrane. Even in women, the absorbents of the glandular substance undergo changes similar to that substance; that is, they become smaller at one time, larger at another, and in very old women, are as much obliterated as the glands themselves.

I first discovered the absorbents of the mammæ in a bitch which had recently pupped; I was injecting the lactiferous ducts with quicksilver, from their orifices on the nipple, and unexpectedly saw the quicksilver fill the absorbents, at the same time it filled the lactiferous ducts; it was one of the lowermost mammæ I was injecting, and the absorbents ran from the groin to the axilla, nearly the whole length of the trunk of the animal. This appearance I saw through the thin integuments, and the dissection afterwards confirmed it. I repeated this experiment on other bitches, and often with the same success. I then made the same experiment, when accident offered, on the breasts of women who died in labour, or on the third or fourth day after they had lain in: the same success attended the experiment in them.

I formerly mentioned, that my first injection of the absorbents of the testicles in men, was accidental and unexpected; and that it happened when I was injecting the *rete testis* with quicksilver, the injection having filled the *rete*, afterwards entered the mouths of the absorbents opening into it; and then quickly filled the vessels to which these orifices belonged. I saw them run along the cord, and pass through the ring of the abdominal muscles, towards the lumbar glands.—I also formerly mentioned, that I had injected ed frequently the absorbents of the kidney from the ureters by filling the latter with quicksilver, without the least rupture of vessels. The filling the absorbents in the breasts of women from the *tubuli lactiferi*, was analogous to what happened in the cases just mentioned; it was no more than I had a right from these experiments to expect; but I was wishing at the time to inject the *acini*, the simple, or constituent smaller glands, of which the mammæ are a conglomeration, as anatomists term it; and the probability of injecting the absorbents at the same time did not occur to me. I succeeded, however, not only in injecting the *acini* to my fullest satisfaction, but in injecting the absorbents also. The *acini* are small vesicles, like Florence flasks in miniature, in these the arteries secreting the milk terminate; and from these the excretory ducts, or the tubes carrying off the milk, take their origin.—The existence of any such vesicles has been doubted; Dr. Hunter doubted, till my injections convinced him of the fact. As there is some difficulty in succeeding in injecting either the *acini* or the absorbents, I shall mention the methods which have succeeded with me. As soon as I have procured the breast of a woman who died undelivered, at her full time, or died on the third or fourth day after delivery, which ought always to be taken out largely, with the glands of the axilla adhering to it: I begin by emptying the *tubuli lactiferi* of their contents; this is done by gently kneading the breast, in warm water, for an hour or two, and pressing the contained milk towards the orifices in the nipple: after the milk is thus squeezed out, and the mamma is become flaccid, I then insert black bristles into the larger orifices, and by means of a glover's needle, surround the tubuli containing the bristles with loose ligatures, ready to be tied when wanted. A glass tube, of a foot and a half, or two feet in length, and half an inch in diameter, terminating at bottom in a steel point, capable of admitting the finest bristle, is filled with quicksilver; the bristle in the orifice in the nipple is withdrawn, the steel point of the tube is introduced in its place; the quicksilver, by its own weight, finds its way into the lactiferous ducts, and from them into the absorbents: when you perceive that you have succeeded, and that all that part of the gland to which this duct leads is tense, you withdraw your glass tube, and tie the loose ligatures, above described, to prevent the mercury's running out

again:

The terminations of the system in the angles of the jugular and subclavian veins are seen as described page 173 and 176.

The trunk from the left lobe of the thyroide gland shews itself.

The whole figure is not yet so complete as I hope to make it; mean time there is nothing put down from imagination.

PLATE II.

Fig. 1. Represents an outside view of the deep-seated lacteals in the beginning of the ilium, which is here slit open, and spread out. The preparation was taken from a woman who died in labour about five o'clock in the morning. The chyle had coagulated more firmly in the vessels than I had ever seen it before in the human subject. The peritoneal, and part of the muscular coats, are removed, to shew the vessels more distinctly.

a, a, &c. Represent six trunks of each side, accompanying the principal trunks of the arteries. They are exactly double the number of the last.

Fig. 2. Represents a portion of the inside of the same intestine, in which several villi, or packets of projecting extremities of vessels, enveloped in productions of the inner coat of the intestine, are seen turgid with chyle, and white as snow.

Fig. 3. Some of these villi, as they appeared when viewed through the microscope: the orifices of the lacteals, and their radiated extremities, are seen distinctly. The lowermost villus was so turgid with chyle that I could see no orifices.

Fig. 4. The radiated extremities of an absorbent vessel entering the gland, as seen by the naked eye.

Fig. 5. The radiated extremities of an absorbent vessel emerging from its gland, as seen by the naked eye.

Fig. 6. A portion of the skin of the arm, after the cuticle, rete mucosum, and some other separable membranes, were loosened by maceration, and removed by the slightest touch of the handle of the knife; where, though I could not discover the orifices of the absorbents, yet the pores themselves are seen more elegant than I ever saw them on any former occasion. The orifices of the absorbents, I believe, are principally situated in the insides of these pores.

PLATE III.

THIS IS MEANT TO EXPLAIN THE STRUCTURE OF THAT PART OF THE GLANDS OF THE ABSORBENTS WHICH IS MORE IMMEDIATELY CONNECTED WITH THE ABSORBING VESSELS.

Fig. 1. A gland injected from the absorbents only with quicksilver, which, on its external surface, immediately after it was injected, put on the same appearances that it afterwards did when it was dried, and viewed through oil of turpentine. I could then see nothing but the appearance of convoluted absorbents.

Fig. 2. A gland injected also from the absorbents only, dried, and seen through oil of turpentine; where, in the outside view, I could then see nothing but the appearance of convoluted absorbents.

Fig. 3. The same gland, as seen through the microscope, exhibiting only the former appearances.

Fig. 4. A gland also injected with quicksilver only from the absorbents, where cells were evident, both immediately after it was injected, and after it was dried, and viewed through oil of turpentine.

Fig. 5. Another gland treated in the same way, which shewed more distinctly the same appearances.

Fig. 6. A gland, one-third injected with quicksilver: the cells, not only at the time of the injection, but after it was dried, and put in oil of turpentine, were perfectly distinct.

Fig. 6. a. The last gland, as seen through the microscope, the cells now as distinct as possible.

Fig. 7. Two glands, injected in the same manner as the preceding; but, instead of being dried, and put into a vial containing oil of turpentine,

were

In the cancer of the *mammæ*, perhaps more commonly found than the cancer of the testicles in men, the poison is generated in the cells of the gland, or in the *acini*; the external absorbents may sometimes carry it from these cells, to the intermediate glands described between the nipple and the axilla; more commonly they carry it to the glands in the axilla; but in time all the glands between the nipple and the angle of the jugular and subclavian are infected. The poison remains in the cells of the mamma, perhaps a year or two, before it infects any gland in the axilla. After this, it may remain a year or two longer in the cells of those glands before it enters the constitution, and kills,—indeed it frequently kills, before it has entered the system. I saw it lately kill, in an open cancer, from repeated hæmorrhage alone; it often kills by inducing mortification in the breast previous to its becoming an open cancer; it sometimes wears out by pain; sometimes drains to death from the discharges, after it has become open. Why the poison should remain so long in the cells of the mamma before it infects the glands, is difficult to say; why it should remain so long in the cells of the glands, is as difficult to say; the venereal poison has been known to lie long in the cells of an absorbent gland, out of the reach of mercury, and as it appeared, has recontaminated the system, without any fresh infection from without. Mr. Hunter mentions a case of this kind. The variolous matter remains eight days in the cellular membrane, after inoculation, before it infects the system: I have known it, when its agency has been prevented by the presence of another specific infectious matter, remain a month, as I formerly mentioned, before it infected the system; and the poison of the mad dog commonly lies five or six weeks in the cells of the cellular membrane before it infects the system: probably this is effected, either by the immediate action of some other infection preventing their action, or from these infectious matters inducing at first the adhesive inflammation in the cells of the cellular membrane, or schirrus, in the cells of the glands, during which states, the office of the absorbent vessels is prevented in the parts; but as the infectious matter comes more into action, the parts go into active inflammation, suppuration, ulceration, and of course a more active absorption must take place. Mr. Freke, in his Art of Healing, though totally unacquainted with the absorbents, (for he makes the ducts of the glands, as he calls them, pour out fluids into the cellular membrane in dropsy, instead of refusing or being unable to take them up) says, " that " in gonorrhœa, the discharge is occasioned from excoriation of the " glands of the urethra, (amongst which he reckons the *prostate*) these " throw out the poison; but if the discharge is stopped, and the mouths of " the glands sealed up by astringents, balsamics, &c. the poison is conveyed " by *certain ducts* to the inguinal glands, and there detained and accumu- " lated." And on this preconceived notion he founded his practice; that is, encouraged suppuration and a discharge, to discharge the poison; or he cut out the glands, or destroyed them by caustic.—His words are, " if " the glands will not come to suppuration, I always, if the patient will admit " of it, divide the largest of the inguinal glands into the body of it, and with " my finger, or spatula, *turn out their insides*, or destroy them with escha- " rotics;—this I take to be the easiest, the safest, and most expeditious " method towards a cure." Every anatomist must know, that what Mr. Freke calls turning out their inside, was turning out the entire gland; chancres also must have been included in his excoriated glands. Dr. Hunter saw this, and acknowledges, that though he taught the lymphatics were absorbents, as early as 1746, yet it was not till the publication of Mr. Freke's book, in 1748, that he thought of the argument of the absorption of poisons, *viz.* that when a poison was passing into the system, the lymphatic glands nearest the infected part were almost always inflamed—he said he caught the hint from reading the passage I have now quoted. Dr. Hunter perceived immediately that Freke's "*certain ducts*," were *sagaciously imagined*, and could be no other than the lymphatic vessels. It is fortunate in these dreadful diseases that the poison lies so long in the first infected parts, because it gives time for removing the diseased parts, and this saves the patient's life. This, however, is not always to be depended on, and therefore as soon as cancerous matter, or the poison of the mad dog, have shewn themselves, I recommend immediate removal of the parts; for though commonly there is time to deliberate, and room for delay, there have been instances to the contrary, and therefore immediate excision is the best and safest practice: sometimes, if the glands in the axilla are cut out with the diseased mamma, the patient may be saved, but this is always doubtful; whilst on the other hand, I have not lost one patient, who submitted to the operation before the glands in the axilla were become swelled, and tender. If many glands in the axilla are infected, the case is desperate, as it is hardly possible every diseased gland can be got at, so as to be cut out. I have seen twenty cut out and tore out without success. Sometimes, as I have already noticed, (page 145.) they surround the axillary artery in such a manner as to make excision, without cutting out the artery also, impossible: they also get entangled in the same way with the principal nerves, so as that it would be necessary to extirpate the arm itself at the joint; even then we could not be sure of success. The disease indeed will seem to be stopt for a year or more, but always returns again, and kills.—The case is equally or perhaps more hopeless, if the mammary absorbents have carried the poison to glands within the chest, out of the reach of surgery, the patient then must die. In the cancer of the testicles in men, we have not even the advantage of being able to cut out the diseased absorbent glands: these are lodged in the cavity of the abdomen, of course always out of the reach of surgery; nor can we form so clear a prognostic in this disease, as in the cancer of the breasts of women; for there, we know whether the glands are diseased or no, as within our sight and feeling, which the others are not; accordingly, I have seen the operation of cutting off a cancerous testicle apparently succeed in men for a year or two, after which, in the dead body, it was found the lumbar glands were infected, and enlarged to a very enormous size.

CONCLUSION.

It appears then, from the foregoing treatise, that the lacteals and lymphatics of the human body are not a trifling appendage of the red veins, but form of themselves a grand system for absorption; and, so far as we have yet discovered them, are not only equal in number to the arteries and veins, but actually surpass them. I mentioned Haller's opinion of their inferiority; he said, "Deinde fateri oportet, post tot industriorum virorum labores, fragmenta tamen esse ea omnia quæ de vasis lymphaticis scimus, neque ullo modo cum arteriarum et venarum aut nervorum historia descriptiones vasorum aquasorum comparari posse."—If I have not entirely disproved this assertion, I hope I have gone some way towards it; and I have no doubt but that the history of his *vasa aquosa* will be soon as complete as that of the arteries, veins, or nerves. I have not only laboured much towards the completing of this history myself, but I have the pleasure to see it every day improving in the hands of my pupils, from whom I have concealed nothing.

The large thoracic duct, plate V. will almost exceed belief; it is exactly, however, as we found it in the human body. The man appeared to be about forty years of age. We know nothing of his history. How it came to be of this size I know not. There was no obstruction in the left jugular and subclavian veins, neither were they enlarged, of course there was no obstruction in the heart or lungs; there was no stricture on the duct itself, near its entrance into the veins; no uncommon swelling in any of the neighbouring parts compressing it here. The great trunks of the absorbents, accompanying the large arteries in the extremities, were in proportion large, but the cutaneous absorbents were not larger than usual. The absorbent vessels, like the veins, become varicose and enlarged from the weakness of their own coats, and their not being able to sustain the weight of their own fluids; but none of the trunks in the lower extremities were varicose, which makes against this supposition. It is somewhat singular, that in three years we should have had so many extraordinary occurrences in the dead body in Windmill-street; first, we found the viscera of the thorax and abdomen completely transposed,* the left subclavian as we usually find it, with the thoracic duct having also crossed over to the right side, whilst the appearance of the right subclavian, and the second trunk of the absorbents were found in the left side; the recurrent nerves were in the same manner transposed; that the intercostal nerves did not appear to be equally transposed, was owing to this circumstance, that there is no mark by which we can distinguish the right intercostal from the left; then we found the human heart without its pericardium; and, last of all, this amazing trunk of the absorbent system. The reader will observe, that throughout this work I have often confessed ignorance, and said, "*why this is, I do not know.*"—I think this confession much better than to attempt an idle hypothesis, which would convince nobody, and of which I myself should hereafter be ashamed. I shall, therefore, conclude with a quotation from Galen, who, in his book on the use of the parts of the human body, expresses himself to the following purpose: "There is a certain length to which we may carry our researches; but if we attempt to go beyond that, we shall soon convince ourselves, that we neither understand our own imbecillity, nor the great ability of him who made us." *Το δε ὅπως εγενετο τοιȣτον εαν επιχειρησης ζητεῖν αναισθητος φωραθήση και τῆς σῆς ασθενείας και τῆς Δημιȣργȣ δυναμεως.*

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* This transposition of the viscera has been published by my colleague in anatomy, Dr. Baillie, in the Philosophical Transactions of the Royal Society, May 1788. The want of the pericardium occurred to him in the moment of opening the thorax, at a public demonstration of the thoracic viscera, and will also be soon published. I once saw the thoracic duct, previous to this period, as large as the carotid artery of an adult, or the barrel of an ordinary writing pen.

EXPLANATION OF THE PLATES.

PLATE I.

THE GENERAL APPEARANCE OF THE HUMAN BODY, SUPPOSED TO BE IN SUCH A MANNER TRANSPARENT AS TO ENABLE ME TO EXHIBIT WHAT PARTS OF THE ABSORBENT SYSTEM I CHOSE.

I DID not think it necessary to put letters of reference on the figure.

The left leg represents the cutaneous absorbents in one of my most successful injections of these vessels.

The right leg represents the same vessels, as injected this winter by Mr. Wilson, my former pupil, and present assistant.

The absorbents on the penis mark only the general appearance.

The absorbents of the testicle do very little more.

The plexus iliacus externus, with the principal absorbent trunks of the right and left leg within the abdomen, are little more than sketched.

The lacteals are seen in plate II.

The absorbents of the kidney every anatomical reader will recognize at first sight.

The thoracic duct is seen at its origin, on the lower lumbar vertebræ, as described page 167.

The absorbents of the stomach shew themselves to every anatomist.

The absorbents on the liver are seen exactly as I have described them, page 184, &c.

The 7 trunks on its upper surface, and at the anterior edge, belong to the diaphragm, as well as to the liver.

The absorbents of the lungs are of themselves evident.

So are those of the heart.

The absorbents of the arms have received some addition this winter from Mr. Wilson's injections.

The terminations of the system in the angles of the jugular and subclavian veins are seen as described page 173 and 176.

The trunk from the left lobe of the thyroide gland shews itself.

The whole figure is not yet so complete as I hope to make it; mean time there is nothing put down from imagination.

PLATE II.

Fig. 1. Represents an outside view of the deep-seated lacteals in the beginning of the ilium, which is here slit open, and spread out. The preparation was taken from a woman who died in labour about five o'clock in the morning. The chyle had coagulated more firmly in the vessels than I had ever seen it before in the human subject. The peritoneal, and part of the muscular coats, are removed, to shew the vessels more distinctly.

a, a, &c. Represent six trunks of each side, accompanying the principal trunks of the arteries. They are exactly double the number of the last.

Fig. 2. Represents a portion of the inside of the same intestine, in which several villi, or packets of projecting extremities of vessels, enveloped in productions of the inner coat of the intestine, are seen turgid with chyle, and white as snow.

Fig. 3. Some of these villi, as they appeared when viewed through the microscope: the orifices of the lacteals, and their radiated extremities, are seen distinctly. The lowermost villus was so turgid with chyle that I could see no orifices.

Fig. 4. The radiated extremities of an absorbent vessel entering the gland, as seen by the naked eye.

Fig. 5. The radiated extremities of an absorbent vessel emerging from its gland, as seen by the naked eye.

Fig. 6. A portion of the skin of the arm, after the cuticle, rete mucosum, and some other separable membranes, were loosened by maceration, and removed by the slightest touch of the handle of the knife; where, though I could not discover the orifices of the absorbents, yet the pores themselves are seen more elegant than I ever saw them on any former occasion. The orifices of the absorbents, I believe, are principally situated in the insides of these pores.

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Fig. 2. A gland injected also from the absorbents only, dried, and seen through oil of turpentine; where, in the outside view, I could then see nothing but the appearance of convoluted absorbents.

Fig. 3. The same gland, as seen through the microscope, exhibiting only the former appearances.

Fig. 4. A gland also injected with quicksilver only from the absorbents, where cells were evident, both immediately after it was injected, and after it was dried, and viewed through oil of turpentine.

Fig. 5. Another gland treated in the same way, which shewed more distinctly the same appearances.

Fig. 6. A gland, one-third injected with quicksilver: the cells, not only at the time of the injection, but after it was dried, and put in oil of turpentine, were perfectly distinct.

Fig. 6. a. The last gland, as seen through the microscope, the cells now as distinct as possible.

Fig. 7. Two glands, injected in the same manner as the preceding; but, instead of being dried, and put into a vial containing oil of turpentine,

were only dried and varnished. They are taken from the mesentery of an ass, and even to the naked eye appeared cellular.

Fig. 7. a. The same glands as seen through the microscope: the cells have a different shape from those of the absorbent glands of the human subject, and resemble exceedingly the convolutions of the cortical substance of the brain.

Fig. 8. An anterior view of a gland, near the spleen of a horse, injected in the same manner as the preceding; also dried and varnished. It resembled the vesiculæ seminales, injected with quicksilver, both in its anterior view and in

Fig. 9. Which is a posterior view of the same gland.

Fig. 10. The same gland, after it was longitudinally divided, and that the mercury, which had long kept its cells distended, had escaped. The cells are now seen as distinct as those of a honey-comb; with this difference, that there are lateral communications between these cells, through which bristles passed with the greatest facility, as here represented.

PLATE IV.

a. A portion of the omentum of a turtle, the trunk of an artery lies in the middle, opposite to letter a; two absorbents, which were injected with quicksilver, lie on each side of the artery; then two veins, one on the outside of each absorbent; and last of all two other absorbents, one on the outside of each vein.

The same arrangement takes place in the branches uniformly.

b. c. d. A specimen of the manner in which a large absorbent vessel splits into a smaller, winding, convoluting, and conglomerated vessel, which after infinite convolutions, again returns to a large absorbent, or ends in the trunk of the system.

b. Is a trunk of the absorbents rising out of the lungs; c. is the thoracic duct going up towards the left subclavian vein; d. is the thoracic duct continued, emerging from under the convolution.

* Represents a smaller specimen of the same kind of dividing and reuniting as the former.

** Exhibits a specimen of convolution in a large absorbent vessel.

e. A portion of the thoracic duct of a horse, to shew its muscular fibres, principally circular, but also spiral, and in various directions.

f. An absorbent vessel from a quadruped, the vessel itself injected with quicksilver, its *arterial vasa vasorum* seen as injected with painter's size, coloured with vermilion.

g. An absorbent from a quadruped, to shew the appearance made by the intersection of the valves externally.

h. Several of these to shew the same thing.

i. Another, to shew variety respecting this appearance.

k. l. Another, the intersection giving it the appearance of a string of beads.

m. A similar appearance in an absorbent from the human subject.

n. A portion of an absorbent vessel from the human body, slit open to shew its valves in an inside view.

o. An absorbent from the human body injected with quicksilver, dried, and made transparent, by putting it into oil of turpentine, to shew a pair of valves hindering the quicksilver from escaping, after the vessel was divided immediately below them.

p. A direct view of these valves in their shut state.

q. r. s. t. The left jugular and subclavian veins slit open at the place where the thoracic duct enters.

r. Is the thoracic duct slit open as it is entering the angle between the jugular and subclavian veins.

s. Are its two valves which hinder the blood of the veins from passing down it.

t. Points to the three valves of the jugular vein at this place, intended to prevent the blood or lymph, and chyle, from going upwards to the head.

u. The jugular and subclavian veins filled with wax, and dried.

v. The thoracic duct distended with quicksilver, entering the angle between these veins.

w. The two valves mentioned at s. seen in their shut state, the injection from the veins having shut them before the quicksilver was thrown into the duct.

x. A portion of the human thoracic duct filled with quicksilver, to shew its tuberculated external appearance; this is owing to the valves placed at the beginning of every branch being shut by the attempt of the quicksilver to pass down, and accounts sufficiently for that want of appearance of ramification here, which is always found in the great trunks of the arteries and the veins, the aorta and cava inferior.

PLATE V.

THIS PLATE REPRESENTS PRINCIPALLY THE EXTRAORDINARY THORACIC DUCT MENTIONED IN THE CONCLUSION OF PART SECOND.

It is seen in situ, with the more immediately surrounding parts.

The spine is cleaned by dissection, and dried, in consequence of which the intervertebral substances are shrunk, perhaps to one-twelfth of their original thickness.

The aorta, vena azygos, and lower portion of the left internal jugular vein, with that portion of the left subclavian vein which forms a right angle with it, are seen as half distended with coarse injection, and dried. The property of coarse injection is, that it loses little or nothing of its original fluid bulk by becoming solid, or even by drying.

The thoracic duct is seen under the same circumstances as the last-mentioned vessels, particularly as little more than half distended with the injection; but we were so long in doubting and examining, that by the time we began to inject this vessel, it could not bear force, and we were fearful of losing it by bursting it.

a. The spine, as above described.

b. b. The aorta, as above described.

c. The jugular vein, forming an angle with the subclavian, under the circumstances above described.

d. d. d. The thoracic duct, as above described.

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Plate 2.

Fig 4.

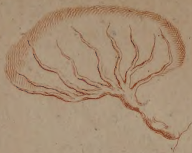


Fig 5.

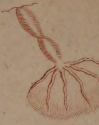


Fig. 1.

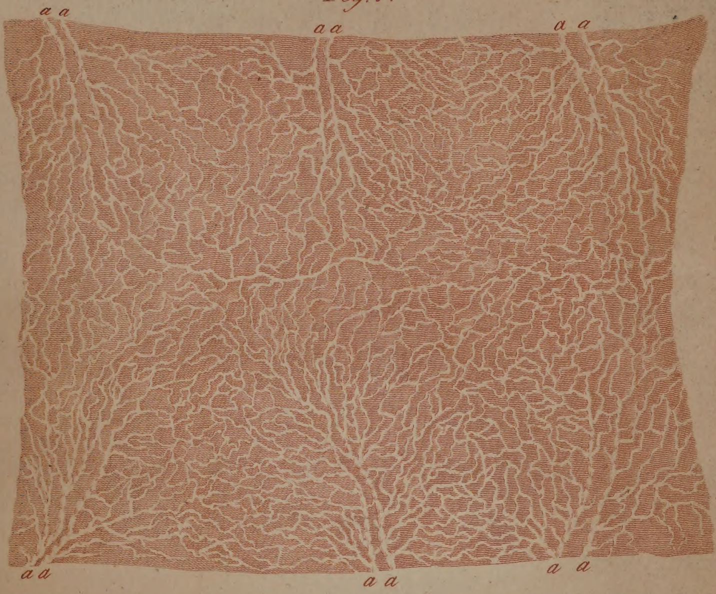


Fig 3

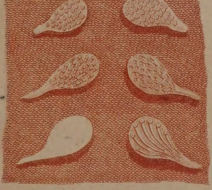


Fig. 2

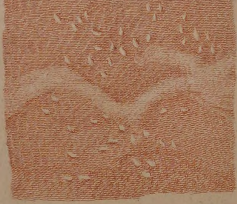
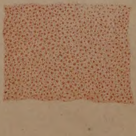


Fig 6



J Thornthwaite Fecit.

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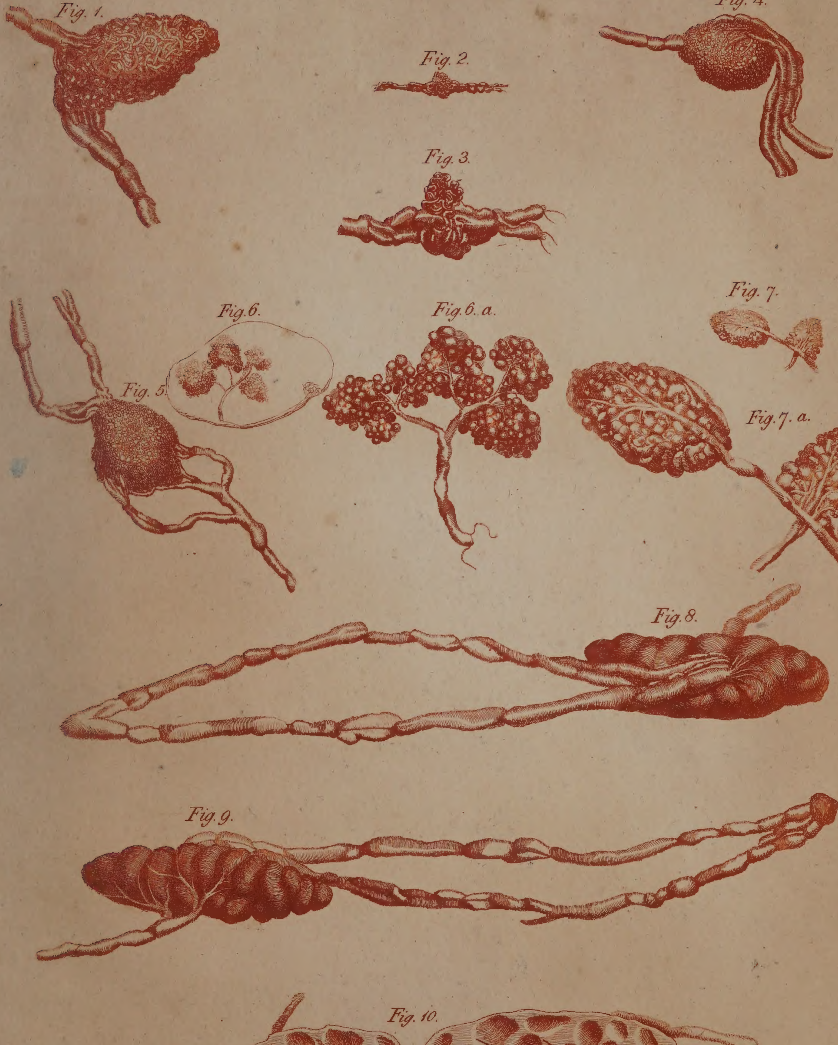
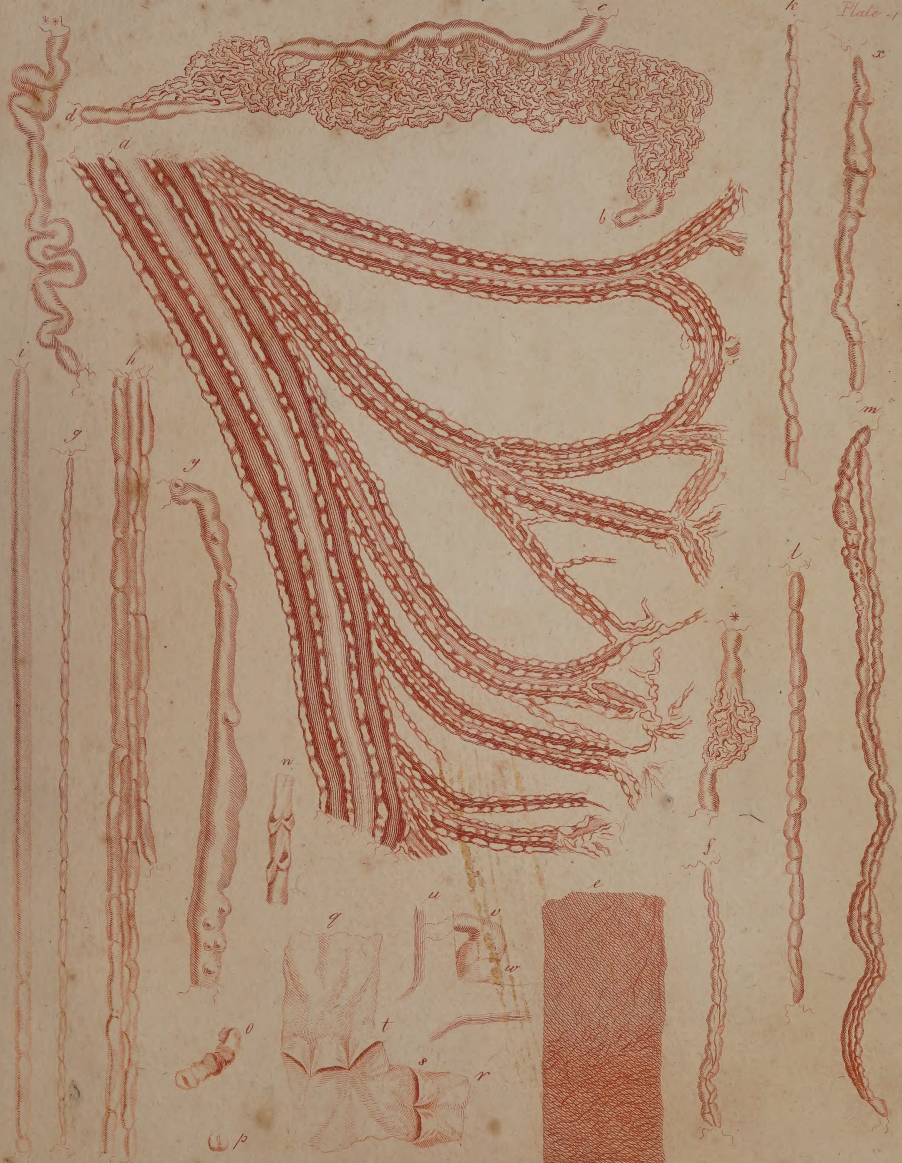
Plate 3.



Fredk. Birnie Fecit.

Plate 1



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Thornthwaite sculp

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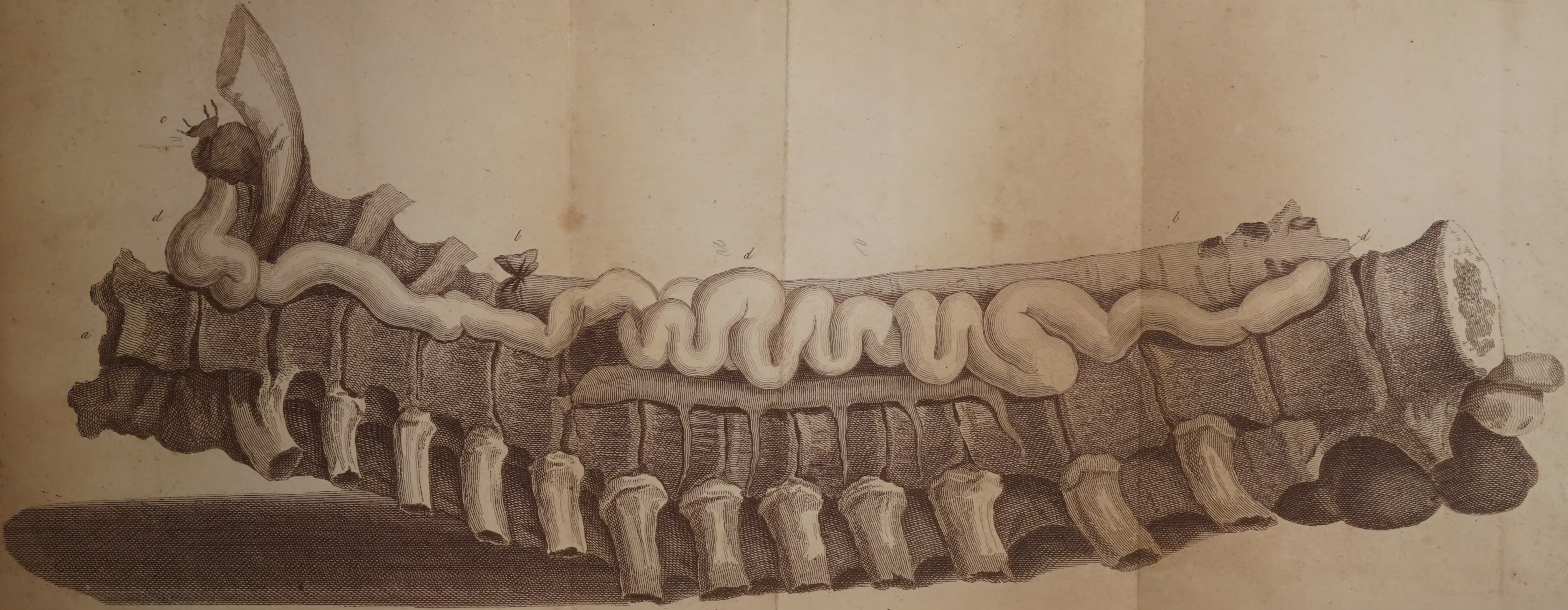

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